VOLUME VI.

BRICKWORK, BUILDING, CONCRETE, DEPRECIATION, EARTH DAMS, FLUMES, LAND, OVERHEAD, PIPE CAST, PIPE RIVETED, RESERVOIRS CITY, RESERVOIR VALUES, TUNNELS

IN THE

District Court of the United States

FOR THE

Northern District of California

SECOND DIVISION

SPRING VALLEY WATER COMPANY, Plaintiff, vs. CITY AND COUNTY OF SAN FRANCISCO, ET AL., Defendants.	Nos. 14,735, 14,892, 15,131, 15,344, 15,569, Circuit Court of U. S., Ninth Judicial Circuit, Northern District of California, and 26 and 96 District Court of U. S. Northern District of California, Second Division.

ABSTRACT OF TESTIMONY TAKEN BEFORE HONORABLE H. M. WRIGHT, STANDING MASTER IN CHANCERY FOR THE DISTRICT COURT OF THE UNITED STATES IN AND FOR THE NORTHERN DISTRICT OF CALIFORNIA, SECOND DIVISION, IN THE PROCEEDING ENTITLED SPRING VALLEY WATER COMPANY vs. THE CITY AND COUNTY OF SAN FRANCISCO, ET AL., IN EQUITY NOS. AS ABOVE.

For Defendants:
PERCY V. LONG, ESQ.
ROBERT M. SEARLS, ESQ.

EDWARD J. MCCUTCHEN, ESQ.,
WARREN OLNEY, JR., ESQ.,
A. C. GREENE, ESQ.,
Solicitors for Plaintiff

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Witnesses: J. H. DOCKWEILER for Defendants.
GEO. L. DILLMAN for Defendants.
ALLEN HAZEN for Plaintiff.

7024 Certain corrections noted in the transcript.

It was arranged that Mr. Bailhache should be allowed to inspect the vouchers of the Western Pacific Railroad Co. in the matter of the tunnel which was changed on account of the railroad being put through the Niles Canyon.

7025 Witness: J. H. DOCKWEILER for Defendants.

Dockweiler CROSS EXAMINATION BY MR. MCCUTCHEN.

On the Sunol work you would have a building where your machinery was installed, and you would have a blacksmith shop, which would include also a place where the auxiliary man would be working. I have a compressor building there, too. I don't know that I have specifically set out the number of buildings, but I would not say that you would want to exceed four buildings, which would be comparatively small ones. I did not give any detailed thought to the sizes of those buildings. You would have a blacksmith shop, and you would have a building housing your compressor. Then you would have a couple of other buildings. I don't know exactly what I would do with them; I just cannot think of it. You would have your electrical machinery in with your compressor.

I assume always that the camp will take care of itself, and I consider that my estimate will carry that. You would probably make
7026 a couple of shifts in your buildings before the end of the job. Those buildings would not cost you much. I have made an allowance, I think, of $1,000 for moving and getting them into the job. I say "Extras, housings, foundations, getting on the job and incidentals" under two items totaling $1,920. That is in the outfit of the Sunol tunnels. That $1,000 is more than is required for getting on the job, but I didn't split that up. I have an allowance of $1,920, which would be ample for that purpose.

I would have a concrete foundation for my compressor. You would not move that foundation, but you would move the compressor, and you would have a new foundation for your compressor every time you moved. I think there would be about three moves. That is,
7027 there would be three foundations—two moves. You would take those buildings down and put them up again, but you would not build them three times. You would have a warehouse for your cement. I didn't figure on how large a warehouse. You would not take that down and

set it up three times, as you do not use your cement warehouse in driving your tunnel. The warehouse you would have for your supplies would be a sort of a partition adjoining your blacksmith shop or machine shop. You would have a little den partitioned off there. The superintendent on the job would have his office, and keep his memorandum there. You would give the superintendent a partition, and have a bunk in there for him. The quarters would be ample. A man has a cot or a bunk, or a bedstead—just what he requires; he has a desk; he has a washbasin and stand, and a shelf for a few books. It
does not necessarily follow that he would not have any toilet arrange- 7028
ments. I would say about $40 for that. The office would be close to the blacksmith shop. A room 14 x 16 would give a man plenty of space to work in.

The superintendent would have the foreman under him, and I cannot imagine what he would want of anybody outside of that crew that I mentioned. This superintendent would be getting about $8 a day, and he has a foreman working on each shift, the night and day. He gives the work general supervision. If it is necessary, he would have a lean-to, and there is enough provision in my estimate there to carry that. I cannot think just now what else is covered by the item, getting on the job and incidentals, $1,000, other than the buildings I have spoken of. I think it covers warehousing. That is $900 housing and foundations, and then I allow for getting on and off the job, and incidentals. I did not mean, when I put that down, "getting on the
job and incidentals, $1,000", buildings, but I do say that it would 7029
not require $1,000 to get you on the job or off the job together; that is available for the securing of what you have outlined.

The $900 covers a blacksmith shop, erected in three places, but it does not include the cement house, as that does not go in in the driving of your tunnel. I have provided in my charge for cement the term warehousing, and that carries it. The $900 was intended to cover the erection of a blacksmith shop three times, a compressor house three times, and the erection of three concrete foundations for the compressor, and the erection of an office three times. The superintendent's quarters are his office, and he is going to sleep in his office. He will eat at the boarding house, and I consider $900, in connection with the other items, sufficient.

I did not select the sites for these three camps, and I do not re- 7030
call the distance between the ends of this line over which you would operate. I had a map before me which showed the locations of this work. I cannot tell you where the first camp would be located, as I did not pick out the site. It was my judgment at the time that only three camps would be necessary.

I do not think that every drift would require ventilation. I do think you could operate from three camps, and get along with 7,000 feet of air pipe. I would not say that four miles was incorrect for

the distance between the two ends of the line over which we would work. I would do everything I could within reach of that equipment at one time. Of course, if I only had 7,000 feet of air pipe, I would be compelled to confine my operations at any one time to that 7,000 feet. I could not give you any more information than what I have already stated about the 3,650 feet of blower pipe. When I al-
7031 lowed 4,400 feet of track, I meant single track of two rails, so that I will have 8,800 feet of rail, and that is what I have allowed for. That rail weighs 16 lbs. per yard.

I have allowed 80 feet B. M. per lineal feet of tunnel for timbering the tunnel as an average, and all of that 80 feet is to be used for timbering the tunnel. I have not thought of any other purpose for which it is to be used, but I have made an allowance of an average for the entire tunnel lengths of that quantity of timber. When I made that allowance it was with the view that all of that 80 feet B. M. per lineal foot would be used for timbering tunnel; that is, the sides and top of the tunnel. The ties would get in with my track. I think my allowance for track includes the ties. I did not segregate it, I just put down "track, feet, $1,000". I said 4,400 feet of 16 lb. rail, $840,
7032 and then below that "extra track, 4,400 feet, say $1,000." The rails, as I recall it, would be worth between $40 and $50 a ton, and 4,400 feet would weigh about 21 or 22 tons, and I took one at $40 a ton. Then I have 4,400 feet here at $1,000, and the average of that would be $45 a ton. I would get my ties out of that timber allowance, despite the fact that I have allowed but 80 feet. I am giving that 80 feet B. M. as an estimate of the timber used, and I am satisfied that in that estimate I would have enough to put in ties. I imagine I would probably use 2 x 4 ties, three feet wide. I have used them that size myself in tunnels I have driven, and it held, which is all you need. The fact
7033 that it held is a test of good construction. I don't know that I have ever seen anybody else use 2 x 4 ties in a tunnel, but I have used them. I will allow you a 4 x 4. I will not stick on a 2-inch thickness of timber. I am satisfied that my allowance of timber is correct. To prove that, I have a memorandum here from Mr. Lawrence, 1,081,000 board feet used in drifting, and my allowance is 1,160,000 B. M. I have 80,000 feet in excess of what the memorandum shows that I got from Mr. Lawrence. I think I have an allowance there sufficient.

I remember the tunnel at the outfall sewer in Los Angeles had 2 x 4's in it. This memorandum of Mr. Lawrence's is a record of all the timber that was used in the Sunol tunnels of the Spring Valley Water Co. I have no details of that. I don't know whether it covers drifting 11,000 feet or not.

Questioned by Master.

I used 80 feet before I made the estimate; then afterwards I saw
7034 that one of my men checked it by multiplying 80 by 14,500 lineal feet.

CROSS EXAMINATION BY MR. MCCUTCHEN.

Multiplying 80 by 14,500 gives 1,160,000 feet of lumber. I don't
know what length of tunnels Mr. Lawrence drove. If you shorten
the length of the tunnel, you would obviously increase the B. M. per
lineal foot. I don't know what length of tunnels he drove, but I am
telling you Mr. Lawrence's figure. I used 80 feet B. M. per running
foot, and on the memorandum sheet I have here, one of my men has
made a computation checking the 80 feet B. M. per foot as to the
amount of timbering I used in my estimate. I did not make the com-
putation myself. This is 14,500 lineal feet, the total length of the
Sunol tunnels; I know that myself. One of those tunnels is drifted
as an open cut, and it is listed here at 14,500 feet. If that is the case,
my timber allowance is larger than 80 feet per lineal foot. 7035

Mr. Metcalf: If you take Tunnels Nos. 1, 3 and 4, the total is 11,900 odd feet, and part of that was in open cut, so it is probably between 11,000 and 11,500. No. 2 was built by the railroad later on, and so it could not be included. Tunnel No. 5 was cut and cover.

Mr. Dockweiler: Tunnel No. 5 I have as open cut, 1,789 feet long. I allow for 4,400 feet of extra track, as I would want to leave my track in the tunnel until I had concreted. I would try and do some concreting before I had finished the entire tunnel job.

Mr. Ellis: Lawrence originally drifted 11,812 feet.

CROSS EXAMINATION BY MR. MCCUTCHEN.

Mr. Dockweiler: I did not give the allowance for the crushing
or other loss of any of my timber while this work is progressing, any
specific consideration. I just made an estimate that that is the timber
it would require per running foot as an average. I don't know that I
made any assumptions as to the overbreakage in these tunnels. Over-
breakage varies entirely according to conditions. If you can take the 7036
time, you can hew out a tunnel to almost the proper size. The Bald
Hill Tunnel is in point as to that. The tunnel driven under the
Crystal Springs Dam, or at least, through one side of the hill against
which the dam is placed, is another tunnel that is driven almost
true to form. The Crystal Springs Tunnel is lined with brick.
I did not see it before it was lined. I could not recall what the over-
breakage was in tunnels of my own experience and observation. I
did not attempt to make any computation on it. I have not recorded
any percentage of normal overbreakage. I have not thought of it in
that term at all. I would expect overbreakage to some extent. 7037

I never saw slabs falling out of the roof of a tunnel after it was driven. I have seen mining tunnels where the material has come out, and I have been through a great many tunnels. That formation happened to be different from the formation you are working in here. I don't recall the exact places where I have seen material drop from the roof or sides of the tunnel, but I know the formation was kind of

flat, and the slabs were falling out. Then there are other places where you would have blocky material, and I have had that happen to me in that very blocky slate, where it was very much broken up by open seams, if you may so term it. Blocky slate lies in blocks; it comes out in 6-inch cubes to a foot, and 2-foot cubes. It is material where you would not use any powder at all, other than pot shots. You would gad it and crowbar it, and loosen it to bring it out. I just put in a set. I would not put in any lagging at all. At a bad place I would put a cap and two posts to hold it. I might, probably, put in one or two small pieces of lagging; then I would go on for 50 or 70 feet, and I would not put in a set at all. That was material for which I did
7038 not require much powder, and it was blocky and seamy. It did not have so very many laminations in it; it was kind of wedged in tight, and you had to work the thing out.

In the formation of the Spring Valley, where a tunnel had to be timbered all the way, the rock would be comparatively easy to handle. The Spring Valley formation is not a blocky slate. Your timber men have to knock off points to get in their sets. You may specify a timber man when he is really a miner, and those men have to round off your tunnel so they can place the timbers in position. You would try and shape your tunnel out to the proper size; assuming this quantity of material, the yardage is based upon making that tunnel so that would catch whatever pockets or overbreak there might be. That is my recollection of the way that quantity was arrived at. It was arrived at as an average thickness. That carries your overbreak, and
7039 fills up the voids for your concrete.

The crew that you have there at the face has to lay the track and put the floor in shape after the shooting has been done. It depends on how you handle it as to whether it is considerable work or not trimming the floor. If improperly handled it is very expensive, because it requires the drilling of very small holes, proportionately, and it is quite expensive to shoot those out. That is generally done by hand. You have a crew sufficient at that place to trim up and face that tunnel as you go along.

The $2.36 which I add to those specific figures is 25% of $9.45,
7040 the labor cost. That is profit and contingencies. I have not segregated it into to profit and contingencies, but have used that as a percentage throughout.

The explosives, 40 cents, includes your powder, fuse and caps. I didn't figure out what the powder would cost; I did not make a detailed analysis of that at all. I just put it down as so much per lineal foot, based on judgment and observation as to what that work has cost.

Mr. Searls: Mr. Lawrence uses 40 cents.

Mr. Dockweiler: I would use dynamite, but the kind would depend; either 40% or 60%, just as the rock showed itself. I didn't

give any special consideration as to the particular kind of dynamite I would use, I just shoved down 40 cents a foot, and I didn't make any detailed analysis as to how many pounds I was going to use, or anything. Some brands of dynamite cost more than others, but I do 7041
not think the price varies much over a period of years. I don't recall what the best powder is designated in the market. You want to use a powder that does not give sickening fumes. The ordinary dynamite gives out a fume that if you go into the face too early it causes violent headaches, and in time may render a person unconscious. There is a powder, I don't recall the name, but I think it is Gillett; I have forgotten the name of it, which costs a little more money, which can be used, and such use permits access to the face almost immediately. I have never used it, but I know that such a powder would be used, and it is the economical powder to use.

If you used that, you would still go to the expense of a fan and blower, as you would want some air there. I don't know why you would go to that extra expense; one thing balances the other. I am just assuming that I would have to use it for part of the work—that is all. I have assumed three 8-hour shifts in order to make the footage that I have counted on. You could get the fumes out in half an hour. I have known of men going into the face of a long tunnel, and 7042
being able to resume work, within half an hour after a previous shift quit. I have seen that practiced in British Columbia. When you fire your shot, you open the air cock of your air pipe, and shoot the air in. That will throw that smoke away back from the face. I would permit miners to go in the face of a tunnel like that within half an hour after a blast. I saw that done in British Columbia.

Mr. Ellis: I have gone in the face many times 20 minutes after a shot, and there was no other ventilation than pipe ventilation. A 7043
blow from the face, and you go right in the face in 20 minutes after a shot. I have gone in there 20 minutes after a shot on many occasions. The back end of the tunnel would be more or less foul, but the face would be clear.

CROSS EXAMINATION BY MR. McCUTCHEN.

Mr. Dockweiler: I do not know whether the company supplied anything for the work on Pilarcitos Tunnel No. 2. I have no information outside of the report made by Mr. Schussler in 1867 with reference to that tunnel.

I have a mule on each shift on this Sunol work. I keep three faces going there at one time. I did not figure out how far removed they are one from another. You would only have one mule to each face. I don't know whether they would all be under the same roof when they were not working. I didn't give that detail any consideration. The mule would be handled the way an ordinary contractor handles a mule. You might have a lean-to and put him under it, but 704

there would be no box-stall arrangement for the mule. There are nine mules; that is, a mule for each shift of three headings. I made an allowance of $1.19 for a mule, and that assumed that animal to work five days in the week. That takes care of the sick chaps, and the extras. The mules are not in the investments; they are in the equipment—the crew. The mule is included in what I call the heading shift; that is, where the drill men are, the chuck tenders, the four muckers, one mule driver, one mule, one shift boss, and one timber man. I have not put him in under equipment; I have charged him in under the working force. That $1.19 is an allowance which gives you interest on the money, depreciation account, produces the mule, and makes every allowance for him. That is to cover the mule whether
7045 you own him or rent him.

I will give you these figures. I allow $1.09 for a horse or a mule as the cost within the City of San Francisco. Outside of San Francisco, and within 60 miles thereof, it is $1.19, based upon the following: The animal is assumed to work five days per week, which equals 260 days per year. The cost of the animal equals $200. Life assumed at five years. Fixed annual charge: $200 divided by 5 equals $40. Interest at 6% is $12, which makes $52. Annual cost of feed outside of San Francisco as follows: I feed him 27 lbs. of hay daily, and that
7046 amounts to 9,855 lbs. during the year. This is an average, and is based on the Southern Pacific's experience with horses and mules; 18 lbs. of grain, which amounts to 6,570 lbs. during the year; 40 gallons of water a day, which amounts to 14,600 gallons a year. That is $184.70 per annum. The fixed charge for interest and depreciation is $52. Food, $184.70. Shoeing, 12 months at $2.50 a month, $30. Harness and repairs, $11.50. Stable expenses, $30. Total, $308.20. Dividing that by 260 days gives you $1.19 per day for your animal. You can rent a span of animals with harness for $25 a month, and you board them. You are renting a span over there in Calaveras for that today. I am conversant with prices. My recollection is I saw a record somewhere or other on the cost of the Calaveras Dam, which showed where a span is rented for $25 a month; that is $12.50 per animal.

I have assumed an average price of $200 for a tunnel mule, and you can buy a tunnel mule for that. We had four mules at the Buclimo Mine, and when we sold them we didn't get $200 for them, and they were ordinary average picked mules. I don't remember what they weighed. On this job I just marked down here a mule, and as to whether he is a big chap or a little one, I don't know. I don't mean
7047 a burro. There is a scarcity of animals now owing to the war demand, but the normal demand during the years 1907 down to 1913 would have allowed you to purchase an animal at $200. I do not know what mines up in the mining part of this state usually pay for good tunnel mules.

My estimate allows for nine cars for driving those 11,000 or 14,000 feet of tunnel. That gives you about three cars to a heading. I would expect those cars to be worn out at the end of the job. I think 7048
they would last until the end of the job. You might bring on some others, but I would charge off practically that amount of cars to the job. I would expect those cars to be in service probably a year. I have allowed a speed of 36 feet per day. As to the number of loads those mules would haul on each trip. I did not give that any consideration. I would probably leave some of the cars at the face, in order that the muckers might be filling them while the mule was out on a trip. As to whether the mule would be going out on some trips with one car, and on other trips with two cars, I didn't give that detail any consideration. I have not analyzed it to see whether my figures lead to that conclusion.

The cost of keeping the six drilling machines in order would be expensive; you charge off the whole machine. I have a charge here 7049
for maintenance and tools, and I have two shifts of blacksmith and helper working; they would be doing something on the machine drills, although they would not necessarily do all. There would be some parts they might make; they might make a bolt. I have seen a blacksmith making a part of a drilling machine in the mine adjoining the one I worked in in Fresno. For instance, he would make a hook to go over the end of the drill where you insert your drill steel. You can buy those parts, but you can make your own, and every man has his own device. Men will have little improvements; the hook may come along with the drill, and it may give out, and then you make one of your own. What I call the hook on the drill is right at the drill where you insert the piece of steel. I don't know what you call it, but it is the device the chuck tender has to loosen up with his wrench every time he inserts a drill.

The sand for Stone Dam Tunnel No. 2 would be a five-mile haul from Millbrae; that is for the concrete lining of the tunnel. In my Exhibit 142 I give the cost of hauling cement, and of hauling brick. 7050
When these figures are reduced, the cost per ton-mile for hauling cement is more than the cost per ton-mile for hauling brick, and that is correct; that is the way the computations show. That is the way I have made the computation. The way I have estimated, it costs more per ton-mile to haul cement than it will to haul brick. At first blush it looked to me as if cement would be the easier of the two to handle. These figures on the cost of hauling cement and sand I made up after investigating from the best sources of information I could secure, talking with men in the hauling business; the cost of loading and unloading cement I take at $1.50 per load. I have here the cost of loading and unloading for brick 75 cents. I carry 1,666 brick to the load, and I have 25 barrels of cement to the load.

Referring to Defendant's Exhibit 141, where I made a change 7051

with reference to Crystal Springs Tunnel No. 1, from a 9-hour day underground to an 8-hour day; I did not make that change with reference to Crystal Springs Tunnel No. 2, because I had estimated that, which was inside the city limits, at 8 hours.

Dillman

Witness: GEO. L. DILLMAN re-called for Defendants.

CROSS EXAMINATION BY MR. MCCUTCHEN.

I do not know of any tunnel anywhere through any class of material that was driven and fully lined with either brick or concrete for $10 a running foot. I have had very little to do with lined tunnels. I have never lined a tunnel with brick, and I have never completely lined a tunnel with concrete. My tunnel linings have generally been timber. I think, in a certain measure, that I used the costs of the tunnels in the Oakdale District as a guide in fixing the cost of running these tunnels that we are considering here. I knew the work of these station men, and I know they were in the state at the time of this supposed work, 1907 to 1913, and my knowledge of what they could do in tunnel excavation was largely derived from watching them do it in the Oakdale Tunnel. They are the same men who made the records on the Los Angeles Aqueduct tunnels. While the digging at Oakdale was a little bit easier, it was
7052 done at a much greater profit to the men. Putting it on a day's wage basis, the estimate per cubic foot of excavation is considerably larger for these Spring Valley tunnels than for the Oakdale Tunnel, so I think I did use that information, but not resolving it directly, without considering that the Spring Valley tunnels are harder material; on the other hand, that is an advantage in a certain way; it should stand better. The Spring Valley material is better to stand than the Oakdale material, and more expensive to excavate. I know it is better to stand because of the hardness of the rock; that is from an examination that I made myself. All hard country rock does not stand well, and it is not a fact that some hard rock stands very poorly, and requires a great deal of timbering.

I have had experience in running tunnels in a slate country, and have met with running ground in such country. You strike running ground more in a serpentine country than you do in slate, although slate runs some at times. I have never found running ground in a rocky granite country, nor have I ever heard of it. Slate has not a definite hardness; there is some soft slate, and some pretty hard slate. Some of the slate near the mother load is pretty hard slate, while some of the slate along the Western Pacific is a fairly soft slate. They
7053 had their tunnel difficulties there more in the serpentine than in the slate.

I have not been very much in the mines of the mother load. I have been in the Jumper Mine in Tuolumne County, which is not

heavy timbered. I have never been in any of the mines at Angels Camp, and do not know whether they are heavily timbered or not. They must timber some drifts as they run them there, but I do not know whether that is harder material than anything you can find on the Peninsula.

I know they have a rock up there that is very prevalent called the green stone, which is very hard. The only tunnels I know of 7054
through the green stone have absolutely no timbering, big or little; those are water tunnels along the Stanislaus. The old tunnels on the north side, one of them through green stone, it was a large tunnel, needed no timbering, and has not any timbering yet. The two tunnels that I drove, called the Owl Creek Tunnels, went through the same material; they are not timbered, and probably will not be.

The Oakdale Tunnels, to which I referred, are in part timbered. I think less than 10% of them is timbered. Material that stands without timbering is pretty good tunnel country, but there is a great difference in the cost of excavating that same material. These tunnels that I have used at Oakdale are soft rock tunnels. As a rough estimate, 90% of those tunnels stand without timbering. The span which is represented by the width of the tunnels is small in the Spring Valley tunnels. The fact that there were no timbers estimated in this inventory seems very reasonable. I would expect to go through those hills in nearly every case with very little timbering, and possibly none. The Merced Tunnel would be an exception to that, and I would expect to do some timbering there. In the other tunnels I have not estimated timbering, because it is not in the inventory, and I only heard they were timbered after the evidence began to come in in this case. 7055

What the inventory shows with reference to the timbering in those tunnels makes a difference in the cost of the tunnels, and because the inventory does not show that they were timbered, I assumed that you could run a tunnel through that country without timbering. I did not make the assumption solely for that reason. From an examination of the country this is quite reasonable, too. I know lots of tunnels that are run through softer stuff than that without timbering, and they stand, too. I don't know of any tunnel run through material identical with these. I assumed that because timbering was absent from the inventory, and it did not seem unreasonable from an examination of the ground, that there would be no need for allowance for timbering for tunnels of that description. Taking into consideration the examination that I have made, and all of my knowledge of the locality in which those tunnels are driven, it is my opinion that ordinarily those tunnels could be driven without timbering, and my estimate proceeds upon that assumption. 7056

The Oakdale Tunnels had a slight advantage over the Spring Valley tunnels in that the material was softer, but I think that soft material requires more timbering, and I intend to be understood by

that that in my opinion the Oakdale Tunnels required more timbering than the Spring Valley tunnels. I have said that not more than 10% of the Oakdale tunnels were timbered, and it is my belief there would be less timbering required on the Peninsula than in Oakdale. Therefore, it is my opinion that not 10% of the tunnels on the Peninsula would require timbering. If those tunnels had to be timbered, I would add to my estimate the cost of the timbering, and that would be $40 per thousand for what was timbered. If the timbers used were
7057 6 x 6 posts and 6 x 6 caps, and spaced four feet apart, and completely lagged with 2-inch lumber, it would take a little less than 55 feet B. M. per foot of tunnel to timber throughout. That would be for a tunnel 5 x 7; I figured it on an average. The installation of that timber would increase the excavation, and I didn't allow for that either. I took the inventory for that. I had not assumed anything. I assumed that that tunnel would be so driven as to throw out exactly the agreed yardage, and no more. I don't know how this yardage was gotten at. I presume this yardage includes all the overbreak, and all necessary excavation that was done. I have not made any figures to know whether that is true.

7058-7059 (Here ensued a discussion among Counsel on the question as to whether the entire computation of quantities for excavation of tunnels should include an additional amount to the amount given in the inventory, and an extra section which would include timbering, if timbering is necessary.)

Mr. Dillman: In Tunnel No. 2, Stone Dam, 3,530 feet long, concrete lined, 4 ft. 4 inches, by 4 ft. 5 inches; the excavation for the dimensions given would only be 2,500 cubic yards. There is in the inventory 5,883 yards, or something more than twice the size of the
7060 completed tunnel. Part of that is occupied by the lining, the thickness of which is not given. That does not look unreasonable; at the same time, so far as I have noticed, I see no figures here by which the actual excavation can be computed. I don't know where this agreed inventory was made, but I have accepted the inventory as correct.

I do not assume that a hole could be driven to the exact size stated in this inventory. There naturally would be a little overbreak. Not over 10% overbreak of the neat excavation. The Oakdale tunnels were run very neat, and the overbreak there did not amount to very much. The green stone tunnels, the most irregular tunnels that were left, were the hard rock tunnels. I know that the overbreak there was not more than 10%. You can walk right through those tunnels
7061 now. They are located about five miles above Knight's Ferry. There were irregular seams in that material, and they did not break well to the seams at all. The overbreak would not exceed 10%.

I could not have said, in my direct examination, that expert tunnel men would not have any overbreakage at all. If I did say it, I want to take it back. There is hardly any tunnel driven with no

overbreak. There is often such little overbreak that it is not paid for. Overbreakage is caused when the rock will not work just to neat lines, no matter with what care the work may be done, nor how expertly it may be done. When I say the overbreakage would not be more than 10%, I think that 10% would be an outside estimate for material of this kind. Of course, there are cases where overbreakage is very serious. One spot of overbreak might cost more than the rest of the tun- 7062
nel. In the Shephard's Pass Tunnel they had an overbreak where they had a hole come in on them that broke out to daylight. I believe it was due to the ignorance of the men in the heading when the break started.

The Oakdale tunnels were in better ground to dig than the tunnels on the Spring Valley properties, but poorer ground to stand. A good deal of the Oakdale tunnels are now untimbered—all of the hard rock tunnels. I think we timbered about 300 or 400 feet of the 7,000 foot tunnel. There was no other timbering in the soft tunnels, except in one place where we timbered a heading to get underground. After those tunnels were dug I timber-lined one of the short tunnels complete, because of the clayey nature of the material it would shrink with the air, and I was afraid of it. I don't know as it was necessary. The tunnels have been operated for several years now, and they are not concrete lining the large tunnel, the 7,000 foot tunnel. The holes were largely bored, and I think you could gouge this material out with a knife. It required shooting. I think you can whittle that material with a knife, and I think you can whittle any material with a knife in which you can use an auger. I think you could pick it very largely; not that it would be economical to pick, though. The other 7063
method would be a cheaper method of doing it. On this Spring Valley work I would not expect to use a pick, except to clean it up a little bit, and I would not expect to use an auger on any of it, because I think it is too hard to bore. I have some doubt about that; I suppose you would run into a little of it that you could bore, but not enough of it to bother changing your operation.

In the Oakdale tunnels, in which we used augers, we bored from 5 to 12 holes into the face before shooting, to a depth of three or four feet. I say that just from casual observation; I have been in the heading many times, but I didn't follow up the work. They were able to make 10 feet on a shift. I think they usually made two shots to a shift. I have estimated the cost per cubic yard on the Peninsula 7064
very much in excess of what this cost on a per diem basis. You cannot entirely use one as a guide for the other, but these are not the only soft material tunnels I have had any experience with. They are not too entirely dissimilar, that knowing the cost of one would not be a guide to the probable cost of the other. These are all soft rock tunnels, and this is not hard rock on the Peninsula; it is harder than the rock I had at Oakdale. It is a stratified rock like at Oakdale. I would

7065 characterize this material which you can whittle with a knife as rock. You can whittle most of the shale with a knife, and you can whittle most of the carboniferous shales with a knife. I don't know that you can whittle any of this material down here with a knife. You would not be able to whittle with a knife the material that you showed to Mr. Dockweiler yesterday.

The Western Pacific, which I spoke of as having trouble in some of its tunnels, had a great many engineers, and a great deal of different advice, but they encountered a lot of trouble there that was not expected when the tunnels were started. That was due to swelling ground in a soft country; it was in the Spring Garden Tunnel, and in a seam in the Beckwith Tunnel. The Spring Garden Tunnel is the tunnel between the drainage of the north and middle forks of the
7066 Feather River. That was a suspicious tunnel from the start. The country rock there was not supposed to be very hard, but the bulk of it was harder than the material through which these Spring Valley tunnels were run, although where they had the trouble it was softer. I was not in the Spring Valley tunnels; that is from my estimate, based on an examination of the country rock. The bulk of the material through which that tunnel was driven was very much harder than the bulk of the material on the Peninsula. The trouble you would meet with from running ground would be very much less with smaller section tunnels than with a section the size of a railroad tunnel. By that, I mean, you could catch it up easier. They didn't have the trouble with the heading in the Spring Garden Tunnel. The trouble was when they got to the bench, and the running ground they encountered was material that came in; it was a schistos slate, and some serpentine. I think in one case it was an angle formed by a couple of seams—but that is hearsay. I did not have charge of this construction; I was in those tunnels a couple of times during the construction.

7067 I have not seen material that it would be almost impossible to stop after it began to run, unless it was quicksand. I have seen pockets left above the tunnel when material ran to a great extent, but that has not occurred frequently in my experience; it has occurred, however. I have not had much trouble with my tunnels, but I have been in tunnels where there was considerable trouble. I have gone into a tunnel while it was under construction, and found a great pile of muck in the mouth of the tunnel, and the face which was not there on the previous shift, and that was due to caves. That has happened in less degree with expertness than with carelessness. It is not an uncommon occurrence, and I would not be surprised if I had repeated experiences of that kind in a good many materials through which I was driving a tunnel.

7068 I have run tunnels other than in the Oakdale District, and on the Western Pacific, principally railroad tunnels. I have had charge of the contractor's forces on the Astoria & Columbia River Railroad. I can

cite the case of a tunnel there through Columnar Basalt, which is about as nasty a material to drill, on account of the wedging of the drills, as you can find. It shoots fairly well, is fairly hard rock; it is a full railroad section that was actually contracted and excavated for less than $25 a lineal foot. I think the section took in about 14 cubic yards to the foot. The contractor did not go bankrupt. That was in my experience, and I was in charge of the contractor's forces right there. This particular contract was a sub of a sub. The man went in and took up the work and finished his job, but I do not think he made a great deal. I think the railroad paid quite a little bit more for the work. I think their price was about $50 or $60. They did not furnish anything to the sub-contractor.

I know about the tunnels that were run on the Peninsula by the Southern Pacific, and they encountered running ground, and had a good deal of trouble, due to unstable ground. This ground is less 7068½
stable than the ground further down the Peninsula through which these Spring Valley tunnels were run.

(Mr. Hazen presented some more photographs, which are copies 7069
of the photographs which Mr. Lippincott referred to the other day in the collection of old photographs.)

(Here ensued a discussion among Counsel, the Master, and wit- 7069-7073
nesses, with reference to the matter of quantity shown in the inventory. The question was as to whether the entire computation of quantities for excavation of tunnels should include an additional amount to the amount given in the inventory, and on extra section which would include timbering, if timbering were necessary.)

CROSS EXAMINATION BY MR. McCUTCHEN. 7074

Mr. Dillman: I think the material on the Southern Pacific tunnels in San Francisco is a little softer than the material on the Peninsula through which the Spring Valley tunnels were driven. I think it is the same formation. The trouble with these Bay Shore tunnels was that they struck some faults where there was some motion similar to Tunnel No. 2 of the Western Pacific in Niles Canyon. That was driven through a fault there, and that was what gave them the trouble with the crushed timbers. I did not anticipate anything of that kind in connection with the small Spring Valley tunnels, and have not estimated anything for it. I would not expect to encounter faults in the Crystal Springs Tunnel No. 2, which is back in the hills. I think it is a quarter of a mile or so back.

A fault is a surface in the ground, along which motion takes place, relative motion. Sometimes these faults are very considerable; sometimes they are small, and have small continual motion, which 7075
makes it a very serious matter for tunnel work. The main difference I would say now between the trouble to be encountered in a railroad tunnel on the Bay Shore and any small tunnel is due more to the

difference in size than any other one thing. The span of a double track railroad tunnel is very considerable, and the material must form some sort of an arch over this. The lining of the tunnel, no matter what it is, does not carry the weight of the hill overhead. The material itself forms a natural arch somewhere up there, so that the lining of the tunnel carries a small weight of material compared to the overhead weight.

I think the material through which the five Bay Shore Tunnels were run is generally a little harder than the Oakdale country, through which I ran some tunnels. I don't think the Oakdale material would hold up in a tunnel of that size at all. There is all the difference in the world between the span that has to be supported in the matter of caving. If the tunnel that was actually needed was a very small, uneven size and shape to work, I can conceive where it would be cheaper to make a hole larger than the tunnel that was actually needed; it could probably be excavated larger with no greater cost per lineal foot. I think, as a general rule, applying that to the smallest of these tunnels, that these tunnels, could all be run cheaper by keeping to the size, rather than by overbreaking it. I don't think there is any general rule about
7076 it. If you have a tunnel say 5 feet wide by 7 feet high, there is no possible advantage in enlarging the section to cheapen the cost per lineal foot. You cheapen the cost very slightly in soft material per cubic yard, but you would certainly enlarge that. If you were running a tunnel in a country that had to be timbered, you could run a tunnel 5 x 7 as economically as you could 7 x 7. I don't know that I ever saw a tunnel 7x 7. The timbers that you would use are 6 x 6 and 2-inch lagging. The 5 x 7 is the neat section I am talking about. You work inside that section and handle cars in there. You could timber and line that 5 x 7 feet tunnel cheaper than you could a 7 x 7. If you made your tunnel 5 feet wide, by the time you got your timbers on each side, you would only have 4 feet, and the lagging back of that would take up 2 more inches on each side, so that your tunnel would be 3 ft. 8 in. wide. The tunnel is generally wider at the bottom than it is at the top, and it is the top width
7077 you speak of as being 5 feet, and ultimately narrowed to 3 ft. 8 in., or whatever it is, and the bottom would probably be a foot or 1½ feet wider than that. That is uniform practice.

It makes it cheaper to run the tunnel if you slope the walls. If the side timbers were vertical, swelling earth would simply push the feet in; if they had a slant, swelling earth does not do that. I would put a drain in that tunnel if I needed it. I would put it on the floor of the tunnel, and its width would depend on the amount of water. I have seen a drain narrower than 12 inches. I have seen a drain in between the rails under the ties.

I had not thought of a mule to use in any of these tunnels. I

might have a plank on the track; it is a good thing to walk on, it is handy. The car man would not have to walk between the two rails; he would walk on either side, or he could walk on the rail itself, with his hand on the car. The width of the track is, say, 20 inches, and he would have plenty of room to walk on the side with his hand on the car. In some cases I would have an air pipe in that 7078
tunnel, and in some cases I would not. I would have an air pipe where it was necessary. If you ran it by power, you would necessarily have an air pipe, but I have not considered you would run any of those tunnels by power drills. This is properly hand work. In some cases you might have a ventilating system, but not all. I think I would put in 6 or 8-inch ventilating pipe. I would put in less than 8 inches; ventilating pipes I have seen have been to ventilate very much larger tunnels, and ordinarily they are from 12 to 16 inches. I don't think now of any 6-inch ventilating pipe, but I am satisfied it could be used very well in these small tunnels. I have seen an 8-inch pipe. There is not a great deal of room in those small tunnels, but I do not think the men would be cramped there.

The car is about 2 feet wide, or maybe 30 inches; I don't remember. If it were 2 feet wide and 3 feet deep, and between 5 and 7079
6 feet long, it would hold a yard of material. I don't remember seeing one 5 or 6 feet long, but I have seen them a good deal longer. That was in bigger tunnels than these. They were not operated by hand power. I would expect to use small cars.

It is much more accurate to figure the work by the lineal foot, without regard to the yardage, in determining the cost of the tunnel. I cannot say that I have any definite starting point in determining what it will cost per cubic yard. I didn't go into the matter of how many feet a crew would make per shift in material such as is encountered on the Peninsula. If my estimate is right of $3 or $4 a yard, and the yardage amounted to a yard to the foot, it meant 3 or 4 feet a day. I have an opinion as to how many feet a crew would make a shift in that locality. I think they would 7080
make more than 3 feet, and less than 10 feet. My crew would consist of about 4 men, who would be doing everything. They would do the drilling, the shooting, the mucking, the moving, and very possibly one of them would do the blacksmithing. They would not be paid by the day. They would be paid in proportion to the work done, and not in proportion to the time spent. I am proposing to do this with station men, and I would expect them to make probably $5 or $6 a day at the prices I have given.

There are a great many gangs of men in the West that do this kind of work. This particular gang I spoke of I am best acquainted with, and I know they were available for this work at that time. That is the reason I mentioned them. It is rather an elastic crowd of men. Men join them and men leave them. They travel about

from one job to another, and they have a certain amount of fraternal feeling and actions, and deal together, and all of them become contractors. They did the Western Pacific tunneling; they did the aqueduct tunneling, but I do not know whether they did all of it; they did my tunneling, and they did the South San Joaquin tunneling. The E. B. & A. L. Stone Co. were the contractors that the Western Pacific Railroad Co. contracted with to do the Niles Canyon,
7081 and from Oakland to Oroville, but they depended on these station men to do their work. I don't know that they did the Stone work; they did the Utah work up in the Sierras, which was very much more expensive than the work Stone had, in the way of tunneling. I was not with the Western Pacific when it did that work through Niles Canyon. I don't know who did the work on the Spring Valley Tunnel that was built by the Western Pacific. Stone had the contract there, and I presume it was very probable that they should contract these tunnels as extra work.

Railroad constructors do not all know how to do tunnel work; some of them understand it, and some do not. E. B. & A. L. Stone are not considered very strong in the world as railroad contractors. The few railroad contracts they have had have not redounded to their credit or their pockets. They have lost on railroad contracts
7082 they have taken, notwithstanding the experience they have had. The most able men have not lost money. I think very likely the Utah Construction Co. lost money on some of its Western Pacific tunnels. That company is the best outfit west of Chicago. I don't doubt that they have lost money, but they have made money in a great many cases, more than they have lost, and in the aggregate they have made a great deal of money in this kind of work.

I don't know who the men were who actually were in charge of the work of running this Spring Valley Tunnel, which was run by the Western Pacific. I only knew of that work as it was going on in a casual way. I saw the statement of the expenses incurred by the Western Pacific in running one of these tunnels, but if I had had that information at the time I made my estimate, it would not have influenced me, because I think I know more about what the cost of those tunnels should be than either the contractor or the men in
7083 charge of the Western Pacific at that time. I do not know the way in which that particular tunnel was worked. I did not know the Western Pacific did that particular tunnel until the year before last, 1914. I think I was with some of the Spring Valley people, who told me so when I was going over the work. They did not tell me what the work had actually cost, nor did they tell me what the Western Pacific had paid for it. I first learned what the Western Pacific had paid for it when the testimony was put in here the other day.

It is very hard to apply the statistics of one piece of work

directly to another, unless you understand not only all the usual facts, but also some of the unusual facts. It runs in my mind that this tunnel was paid for by the Western Pacific at about $15 a foot, and that it was sub-let to the men who did the work for $9 or $10 per lineal foot. Now I know that early in the progress of 7084
the Stone estimate there was considerable friction between the Engineering Department of the Western Pacific and the Stone outfit; while this discrepancy seems great, it sounds to me as though it was something of a sop thrown out to the Stones to stop some of that feeling and friction.

I only know that it was sub-let for $9 on what I heard here the other day. I don't know who said it.

Mr. Searls: I think it arose this way: Mr. Lawrence gave a value of $9 as the cost, and I think I suggested it may have been sub-let for that; I think that was all.

CROSS EXAMINATION BY MR. McCUTCHEN.

Mr. Dillman: I wrote on behalf of Dockweiler to the chief engineer of the Western Pacific, I think, and asked him for the cost of the tunnel, and if he wrote to me, I turned the letter over to Dockweiler, and have not seen or thought of it since. If I knew the actual cost of this tunnel to the Western Pacific, on or about April, 1914, I didn't remember it. I do remember asking for some information, and I think it was that kind of information for Dockweiler's benefit.

The knowledge of the cost of one tunnel would not be of much aid in determining the cost of another tunnel, unless you understand all the attendant circumstances. If I had knowledge of the cost of the tunnels, I don't think I would disregard and discard that information entirely. In this instance I don't think I ever remembered it from that day to this. I passed it on to Mr. Dockweiler, 7085
and it didn't make any impression on me. I didn't regard it as of any value in giving the proper cost of the reconstruction of that tunnel. I apparently did not regard it as giving the proper cost of the tunnel when it was constructed.

I have not attempted to use the information on the tunnel in Shasta County, which is reported in the Engineering Record, and which I have never seen. That is only corroborative of the fact that tunnels are driven for considerably less money than Mr. Hazen states in his evidence. I didn't know anything about that tunnel, except from hearsay. The actual cost of anything the Western Pacific did would have very little effect on my estimate. I referred 7086
several times, on my direct examination, to Western Pacific construction, but not as evidences of cost. I referred to Western Pacific construction as part of my experience in running tunnels, but I said I would not pay much attention to what they had paid for

work in making an estimate on the proper cost of that work. The sections of the tunnels of the Western Pacific, as to shape, are very satisfactory. I have not made my costs, based on any one set of past costs, as my experience. My experience extends not only to the Western Pacific, but to the Union Pacific, and to the Burlington, and the Portland & Puget Sound, the Astoria & Columbia River Railroad, the Nevada Northern, the Oregon Railway & Navigation Co., and a great deal of other work at various times. I have not related my estimate on these tunnels directly to any one tunnel, or any one set of tunnels, as closely as to the Oakdale work, with which I was recently connected; it went on during the time that this work is supposed to have been done, and was finished in 1913. I knew more of the main facts then than of the collateral facts and conditions there. They were small tunnels. Therefore, I considered them
7087 more pertinent than any other tunnels. I refer now to the north side Oakdale tunnels; there are 5 or 6 tunnels there, which run through soft material. The material through which those tunnels were driven was a little bit softer than the average of the Spring Valley tunnels, and by that I mean you could bore them instead of having to drill them. You could not bore the Spring Valley tunnels. You can whittle that material at Oakdale with a knife. The Spring Valley Peninsula material and this Oakdale material is all soft material, but that material at Oakdale was enough softer so it could be bored. I do not think the Spring Valley tunnels could be. They would have to be drilled. I think that the cost of drilling would be the main difference in the cost of the tunnels per yard.

It is my opinion that there is a comparison between those two materials. The main difference is the way in which the holes must
7088 be put into the material. That is, the instrument you would use. In close-grained granite I might have to use power drills; I might not touch it with hand drills. In the one case the material would be so hard that you could not use an auger, and in the other case it would be so soft that you could use an auger, and I say you can use any experience in driving a tunnel in one of these materials for the purpose of determining the expense of driving a tunnel in the other; the main difference is in the cost of driving the holes. I think the hard material would shoot almost the same, and possibly better than the soft material of Oakdale. It would cost about the same amount of money to muck and handle the material after it is shot.

I would not expect to bulldoze much of this material. Possibly once in a while you would get a block that you would have to bulldoze, but very few. We had to break the material with a sledge at Oakdale before the men could put it into the car, but notwithstanding that, one crew could take out from 8 to 10 feet of it on
7089 a shift. I think if you will give me a little time I can cite a good

many hard rock tunnels where they have taken out more than 5 feet. In my own experience I have made more than 5 feet on a shift. I have heard of 5 feet being taken out in an 8-hour shift in material in which it was necessary to use a drill. It was material about as hard as the rock probably was down on the Peninsula; it is not exceptionally hard rock. It was in the headings of railroad tunnels, which is a test; a railroad tunnel is taken out in two parts, a heading which is run ahead, and then the bench which is taken out afterwards. They do it in that way because they can get ahead faster than they can by working the whole face at once, and in the aggregate I think that it is cheaper. The material coming out of a heading is simply wheeled in wheelbarrows ordinarily. There is not ordinarily a track in there, unless it runs in a great distance 7090
ahead of the bench; that is simply dumped out over the bench, and is handled by the mucker. In recent practice they use a steam shovel, and they have tunnel shovels now, and go right into it that way.

My allowance for timber in place in timbering these tunnels was \$45 a thousand, which would be 4½ cents a foot B. M. I would cite in corroboration of that the contract price that was introduced here in the case of the Stone Tunnel; they paid \$40 a thousand for that. I don't see any estimate for timber in these tunnels of mine at all.

Questioned by Master.

If it is in the inventory, it is estimated. If it is not in the inventory, it is not estimated.

CROSS EXAMINATION BY MR. McCUTCHEN.

Referring to overbreakage, which I did not allow because I did not find any in the inventory: Those figures in the inventory represent the amount excavated as agreed upon between the representatives of the Spring Valley and the City. I know that there is an opening there of a certain size, but I do not know that the lining is of a certain thickness. The lining is given in quantities in the in- 7091
ventory, and I did not concern myself with the thickness of it. I did not assume that a hole was broken out which would have been made by the removal of just the quantity of material found in the inventory, and that the hole was not any larger than that in any case. I assumed that the inventory included the material that was broken out, included overbreak, and it should; if it does not, it is not my fault. There is sure to be some overbreak. In most cases of small overbreak it is so small that it is not estimated; the contractor stands it. If it is a large overbreak, and unavoidable from the seams of the rock, the custom is to pay him anywhere from a quarter to the whole amount of the overbreak at the contract price per cubic yard. I assume that the overbreak is included in the yardage, and I have allowed full price for it. I didn't make any inquiries to

ascertain how that yardage was obtained; when I started this estimate, I only started it with the statement that here was an agreed inventory, and except in one or two cases where there was an evident mistake, I have not made any corrections to this inventory at all.

I assumed that they would have to do some temporary timbering in the Lake Merced Tunnel, and I think that is the reason why I left my tunnel price per yard way above what it would cost to cover that amount of timbering.

Questioned by Master.

7092 The $4 for the 3 items of excavation is very much in excess of the actual cost of digging sand, and getting it out of the hole. I suppose there would have to be some protection there, I didn't know what it was, and I never heard how difficult it was until the other day, so I made my sand excavation the same price as my rock excavation.

CROSS EXAMINATION BY MR. MCCUTCHEN.

I never drove a tunnel in wet sand. I got into a tunnel once that gave me a good deal of trouble, in dry sand. That did not run $4 a foot. I didn't run this for $4 a foot either. This cost $8. The unit I have used is $4 a yard. I did not know that this work was below the water level, but I take it for granted now that it was. I don't know that my price is a reasonable one in view of the evidence that has come in here, and which is entirely new to me. I am not sure but what that water would cost more than what I have estimated for it. It might raise the price of that tunnel a good deal. It is not all bad digging, though. From a study of the profile, there is a good deal of hard ground. They did have some trouble in the middle of that tunnel that I never heard of until
7093 just a day or so ago.

Probably out of that $4 I allowed $2 or $2.50 for timber on the Merced Tunnel. That was not my intention, as I had no intention when I put these figures down. I considered they would have to have some protection. I didn't know what it was, and I didn't estimate in detail what timbers there were. I did intend to allow some of the $4 for timber. I did not find any indication in the inventory that the timber was used in that work. I allowed timbering there because it seemed evident to me on the ground that you would have to protect yourself by timbering in that kind of material. That is not as good material to stand as any of the other tunnels on the system. The only reason I did not allow the timbering on the Peninsula was not that there was not any timbering on those tunnels shown in the inventory, but I did not think the ground needed timbering. The absence of timbering in any case in the inventory did induce me not to allow for timbering, and also the

fact that in one case it seemed reasonable, and in the other it did not seem reasonable that it could get along without timber. I did not assume, when I made that allowance, that this was dry sand. 7094
I expected you would find a little water in there, but I did not assume that it was water under pressure. I assumed that that sand was in a normal condition, more or less wet than sand ordinarily would be at that depth, and assuming that, I made an allowance for timbering. The Lake Honda Tunnel is a smaller tunnel, and the dimensions of the tunnel have something to do with the running of sand, if you are driving it through sand. I think a small tunnel would stand much better than a wider tunnel when driven through dry sand.

When the inventory says "earth 50%," I do not necessarily understand that that is sandy material.

Mr. Dockweiler: The Twin Peaks Tunnel on the west end is 7095
run through sand, where the contractor parallels the Lake Honda Tunnel. A sandy clay is the material. I would not work men in the sandy part of the Lake Honda Tunnel of the Spring Valley without timbering it. Some parts there have a kind of a sandy clay, but through what I should term sand, I should estimate the timber, and then a little section of it that is chirtle, that stands very well.

CROSS EXAMINATION BY MR. McCUTCHEN. 7096

Mr. Dillman: If I thought the Lake Honda Tunnel needed timbering, I would certainly protect the men by putting it in. I did not allow for anything outside the inventory. I didn't allow anything for timbering on the Lake Honda Tunnel. I might, or I might not send men in there without timbering, simply depending on developments. My estimates, so far as the timber was omitted, and should be put in, are undoubtedly lacking. I don't know whether it would be necessary or not to timber any of that. I think in an original estimate, where I was getting the quantities and making this inventory, and where I had no knowledge of the fact as to the actual construction, that I would allow quite a little for timbering there. It is quite a good deal softer formation than 7096A
it is down further on the Peninsula, and I think very likely I would allow in that kind of an estimate for some timbering, but I have not allowed in this estimate for any timbering, because it is not in the inventory. I made the allowance on the Merced, which is not in the inventory, because it is evident that you would have to timber there, while it is not quite so evident on the Lake Honda Tunnel. The fact that the timbering is absent from the inventory is the principal fact that I did not allow it. The other fact is that it did not seem to require any timbering absolutely, and being omitted, I have left it out. I assumed, in the case of the Merced, that it was an omission, and I assume now that all the timbering you would

use there would be temporary timbering, and not what you would call permanent timbering.

Referring to a photograph, one of a set of photographs offered
7097 in evidence today, on the bottom of which it says: "Lake Merced "Drainage System Tunnel, May 20, 1896, No. 45-B": If those timbers were temporary, I don't know whether they could be taken out or not. I think I should leave them in if the hole was big enough without them. If you took them out, very probably you would get your tunnel full of sand. You would probably not have any tunnel a little while after you took them out. They show considerable pressure, and some distortion. They show the necessity for timbering. When I said that if the Merced Tunnel were driven from the outlet end, you would not need any appliances to take care of the water, I mean you could drain the water out of the tunnel without pumps, and all that that would do away with would be pumps. If I was in such a hurry, and could not spend the time, undoubtedly that would be the way to construct it. That would obviate the sloughing of the material at the face; as you trim it, the sloughing would probably be decreased. This trouble in the Merced Tunnel must have come from water under considerable pressure, that the opening up of the head released; as you progressed, the drainage would decrease that trouble.

I don't think I have ever seen any figures on the cost of run-
7098 ning tunnels in wet sand, and I have not had any experience in running tunnels in such materials myself.

The unit prices per yard do not apply when you are contrasting very small with very large tunnels, but within a moderate range of size, the cost per yard is the most nearly constant way of getting at it, much more so than the cost of lineal foot. The cost per yard would be increased in the same material for the smaller tunnel, but I cannot tell how materially increased. I can estimate it by an examination of the ground satisfactorily to myself and my clients in any given case, but I cannot tell the ultimate fact.

The custom with reference to running the floor of a tunnel on an exact grade is to take the floor out a little bit low, and then let the spilling from the cars, and the trimming up for the timbers, and so on, fill that up so it won't have to be taken out again. It has happened that the grade is found to be heavy, and it is necessary to take out a section of the floor later on, but that would be from bad instrument work, if it were done. It is not common, but I have known it in my experience. It has not frequently happened
7098½ in my experience. In tunnel work in my experience it is uncommon. I have had it get too low oftener than too high.

7099 I do not know of any tunnel of any size anywhere that was driven and concreted for $15 a foot. My experience with lined tunnels is very small, but I recited a contract which has been let,

and is now being executed, for a tunnel concrete lined that contains more material than the Peninsula tunnels of the Spring Valley Water Co., more excavation; I don't know how the lining will pan out—for less than $15 a foot. That is not completed, and the contractor may fail. I do not know of any tunnel, concrete lined and completed, the cost of which was as little as $20 a foot. My experience with concrete or brick lined tunnels is very slight. I have never built one myself. I do not know of one that has been built and concreted for less than $50 a foot.

RE-DIRECT EXAMINATION BY MR. SEARLS.

If I were to find that the greater number of the Peninsula tunnels of the Spring Valley Water Co. were actually timbered throughout their entire length, that would not be conclusive to me that it was necessary to timber the ground in order to support it during construction. They might have intended to delay the lining for a period of a few years, just as we did at Oakdale. As a mat- 7100
ter of fact, in time nearly all tunnels will have to be lined, many of them having stood 25 and 30 years, and the timbering is only a temporary thing compared to the permanently concrete lined tunnel.

Dillman's appraisal of city properties was then introduced and marked "Defendants' Exhibit 101a". 7101

(With the consent of Counsel for Plaintiff and the Master, Mr. 7101-7102
Dillman, at the request of Counsel for Defendants, is to prepare such corrections in his estimate of these tunnels as he would deem to be necessary to allow for the amount of timbering that he would deem reasonable if the tunnels are to be timbered, and if the inventory does not govern in that respect. The basis of his assumptions are to be made on the assumption of the amount of timbering that Mr. Lippincott has estimated, or assumed, for these respective tunnels.)

RE-DIRECT EXAMINATION BY MR. SEARLS.

In figuring my brick work, outside of tunnels, I think the range of prices I used was from $20 to $25 a thousand in place, including mortar, hauling, and everything. I think the haul was the cause of the principal variation in the prices. I did not analyze it much, but I knew, and had in my mind all the time that the Remillard brick on board cars near Pleasanton could be had for about $6 a thousand, and the freight haul to the different points on the Peninsula would probably be about $1 a thousand. That isn't from any rate that I have gotten from the railroad, but is assumed, and the error, if any, is small compared to the probable error in the cost of laying, and so far as I have assumed anything in the cost of brick, I have assumed it at $7 on board cars at different points on the Peninsula.

I assume that common brick, such as has been priced here in
7103 this discussion, is suitable for hydraulic work of this sort. From an examination of the brick work that I could see, I think the brick used was simply good hard red brick. In outside work a mason will lay from 1,000 to 2,500 or 3,000 brick a day, and for tunnel work about 1,000 a day. Brick work has been more or less common, although I have not done much of it, ever since I was a small boy; the common price when I first knew about laying brick was $13, and $14 laid in the wall. That was for ordinary straight building walls. The price has gone up somewhat from that time, until now, with a reasonable haul, it is probably $17 to $20 a thousand. The last brick work I had done was the curbing of a 14-foot wall about 50 feet deep, and while I do not remember the exact prices, the cost of brick on board cars was between $11 and $12 a thousand, with a haul of a little over a mile through very sandy roads, so that large loads could not be hauled to the site, and the price was in the neighborhood of $25 a thousand for the brick in place, including mortar. I don't know how the price of brick has decreased in the last 15 or 20 years, except from hearsay. I, at one time, was offered a large lot of brick in San Francisco at $4 a thousand, but I had
7104 no immediate use for it, and I did not care to speculate, and did not care to take it.

Questioned by Mr. McCutchen.

That was real brick, and it costs about that to burn brick under fairly favorable circumstances.

Hazen

Witness: Allen Hazen re-called for Plaintiff.

Questioned by Master.

A very small amount of lime has been used in mortar, sometimes with the idea of making the mortar less permeable, but when we used to use brick in hydraulic construction, lime was never permitted. We always thought it was injurious to the strength, and to long continued durability, and excluded it.

Questioned by Mr. Searls.

I do not know whether lime was used in the brick mortar in the Spring Valley works. It does not make any difference in the
7105 cost of reproduction, because it is estimated as an additional ingredient, and would perhaps facilitate the work of the masons a little, but it seems to me it is immaterial from that standpoint. If we were going to build it, we would discuss the merits of it.

Questioned by Mr. Dillman.

It is claimed that it makes it hydraulically a little tighter, but I have been rather skeptical about that. There may have been something in it, but if the lime is imperfectly slacked, it has always pieces that are not slacked at the time and slacked afterwards, and

if they are imbedded in your mortar, the slacking afterwards has a disintegrating effect. We get that sometimes where lime is used in buildings; that is something I would not want to have happen in any hydraulic work. It does not make much difference in buildings, but I would not want it in walls that had to be water-tight.

DIRECT EXAMINATION BY MR. GREENE.

There are eleven city reservoirs, holding altogether 92,000,000 gallons, and the estimated cost of reproduction of which is $865,819. I have here a sheet which may be convenient as a list, showing the reservoirs and their capacities, and the estimated cost of reproduction. The overhead and the depreciation are also shown on this sheet. I also put the corresponding data on one sheet, perhaps as a matter of convenience, for the three impounding reservoirs of this system; this is a copy of the data in my note book, which I made up for my own information, and which, I think, may be convenient at this time. It has no significance, except as a summary of the figures which are otherwise stated.

This sheet is as follows: 7106

No. 2192 7107

Spring Valley Water Company
Appraisal Department.
Allen Hazen

COST OF RESERVOIRS, STRUCTURES ONLY—AUGUST 2nd, 1915.
(Copied February 10, 1916.)

Reservoir.	Cost to Reproduce Without Overhead No Land (1)	Cost to Reproduce Including Overhead and Less Depreciation No Land (2)	Approximate Capacity in Millions of Gallons (3)	Cost per Million Gallons Columns (1) & (2) (4)	(5)
Pilarcitos, including feeder flumes	$ 395,747	$ 501,578	1,000	$ 396	$ 502
San Andreas, including Bald Hill Tunnel	650,938	799,598	6,000	108	133
Crystal Springs, including old dam	2,034,602	2,406,081	22,500	90	107
University Mound	210,428	257,877	37	5,700	6,900
College Hill	70,090	81,133	14	5,000	5,800
Honda	396,931	449,290	33	12,000	13,600
Potrero Heights	26,053	32,193	1.00	26,000	32,000
Lombard Street	38,116	48,186	2.50	15,300	19,300
Francisco Street	63,742	49,261	3.00	21,200	16,400
Clarendon Heights Tank	16,135	18,792	0.50	32,300	37,500
Clay Street	17,040	19,554	0.25	68,000	78,000
Presidio Heights	23,925	29,685	0.70	34,000	42,500
Oceanside	2,023	2,371	0.02	101,000	118,000
Meyer	1,336	1,583	0.02	67,000	79,000
Totals & Averages:					
3 Storage Reservoirs	$3,081,287	$3,707,257	29,500	$104	$126
11 Distributing Res.	865,819	989,925	92	9,400	10,750

7108 The principal items in reservoir construction have already been covered by me in a general way in discussing concrete, brick work and excavation, and they are summarized in "Exhibit 111". I will now take up the reservoirs briefly, beginning with the University Reservoir, on page 216 of the inventory. The first item is for earth excavation, for which I have estimated 40 cents per cubic yard. I have estimated the earth work for these reservoirs exactly as I should have done in the eastern part of the country, where I am more familiar with cost conditions, and with the idea of adjusting it if necessary for the California conditions; with respect to this earth movement, conditions outside, it seems to me that the advantages of climate practically offset the higher rate of cost as compared with eastern conditions, and the prices that I have used here for the earth are practically just the figures that I would estimate if the work were similarly located in the northeastern part of the United States. For these earth works the haul, which I think averaged 700, 800 or perhaps 900 feet, was most of it down hill; a great deal of the material being deposited as surplus in adjoining lower lots, and some of it being placed in the embankment which goes part way around the reservoir. The uphill part of the haul at the last need never be deep, as the distances were considerable, and the height to which it was elevated not very great. It is a good steam shovel job, apparently.

The material is a fairly heavy material, but not offering any special difficulties in excavation. The next item is for compacted fill, and that I understand represents that part of that embankment
7109 which is artificial, and this material is part of the material covered by the preceding item. In other words, most of the excavated material was wasted, but this part of it was put into the embankment, and the 25 cents represents the added cost of putting it in the embankment and compacting it to make a suitable water-tight structure.

The macadam bottom was rather an unusual item; it seems to take the place of puddle, and to have been used in the same way; why it is classified as macadam instead of puddle, I do not know. The 42 cents per square yard which I have used amounts, I think, to \$1.50 a cubic yard. The concrete slopes and bottom I have estimated at \$12 per cubic yard, and the prices for concrete have already been discussed. That is practically sidewalk work. They are put down in squares, and given an excellent finish. Asphalt paving is a walk around the top of the reservoir, and the water-proofing on the sides and bottom is estimated at 3 cents a sq. foot. The boat and gage board are small items. The items on the following page of the inventory are for piping.

7110 As far as my figures are these original figures, they do not make any difference with the agreed figures for the buildings. I

have not corrected this for that. That may be true frequently with other items as they go ahead. I won't attach any importance to them as far as it is agreed to. The piping was estimated at prices which were used throughout the system, and which were believed to be fair. It is a small item.

Questioned by Master.

That is not included in the City Distribution System that is agreed. On page 218, fences, cultivation, trees, lawns, and shrubbery, I think that was an estimate made by Mr. Roeding, the agricultural expert of the company. The inlets and outlets were estimated at prices that I believe to be fair for the respective items. There is some 44-inch riveted pipe coming into these, and I think that is really a part of the main line, in this case the Crystal Springs pipe line. It is separated in the inventory simply because it happens to be on the inside of a reservoir fence. I estimated it at the same prices per foot as are used for the main lines, on the assumption that it really was a part of the main line, and would have been built at the same time, and under the same conditions.

I think the tunnel on page 219, structure 11, is not a real tunnel, but rather a deep cut, through which some of the outlet piping 7111
was carried, and it was estimated in that way, and not as a tunnel. The buildings on page 220 are agreed upon. There are some more sewer and water connections on the following page. I do not understand that these water and sewer connections are in the stipulated valuations.

DIRECT EXAMINATION BY MR. GREENE.

The first item on page 222 is for the screens, and those are the screens through which the water would pass before it went on to the city; these screens carried a great deal of brass wire mesh, which represents quite a substantial expense. On some of the older screens that has fallen into decay, and has been replaced with cheaper material, but on a large part of the screens the full equipment is still available, and this estimate was made up based on the cost of the materials, with an allowance on the carpenter work in putting it together, $20 for each screen. The weir-box is an arrangement for measuring the water, and is estimated much as flumes were estimated. There are some little structures of flumes, but I do not understand that they were included in the agreement on flumes. The total for this reservoir is $210,428 without overhead. The first two or three items make up a very large percentage of all of it. 7112

I took as a starting point 65 cents, which I think is about the cost of getting out that material, and putting it into a reservoir embankment, rolling it, and making a reservoir structure of it; that is about the going price in reservoir cosntruction that I have

known about in the East at the present time, and within the last ten years. If higher figures or lower figures are obtained, it depends upon the character of the material somewhat, and it is something that must always be a matter of judgment. In other words, there are so many little differences that cannot be classified and allowed for in a specific way that a comparison with other work has to be rather in general terms. I could tell you what the cost has been on this reservoir and that reservoir, but none of them would be strictly comparable, and I do not know anyway that I could make you a schedule that would show just why there are differences in the different cases. It is my judgment that the 65 cents is a fair price for handling that material in that way; then for the part of the material that did not go into the embankment, but was excavated and spilled, obviously the lower price would be allowed. I think 40 cents and 25 cents are a fair division of the 65 cents.

7113 I have built quite a number of reservoirs; I have examined a great many reservoirs, seen their weaknesses, and where they had trouble with leakage, and I have seen the methods of construction, and been somewhat familiar with the costs.

NINETY-EIGHTH HEARING. FEBRUARY 16, 1916.

Witnesses: Geo. L. Dillman for Defendants.
Allen Hazen for Plaintiff.
Geo. A. Elliott for Plaintiff.

7114 Witness: Geo. L. Dillman re-called for Defendants.

Dillman The question of the amount of material in concrete was quite different on the two sides of the case. A block of concrete was gotten
7115 from the Crystal Springs Dam, and this went through an experiment at the Bryant Street Yard, which was very satisfactory to Mr. Hazen and Mr. Metcalf, and very unsatisfactory to me. I knew that there was considerable error, and until I had studied the matter over, I was not prepared to say just what the effect of the error was. The error was due to ignoring the porosity of concrete. Subsequent experiments have shown me that 15% of the volume of this particular concrete is voids so far as material other than water goes. When these voids are filled with water there is an error in that kind of an experiment, and when they are filled with air, the error is still worse with the method used.

On the 29th of December, 1915, this piece of concrete was delivered to the office of the Badische Co., 592 Howard Street. They had nothing to do with these tests, but had a laboratory that was temporarily unused at that time. On the 30th of December the piece was

weighed as found, and was found to weigh 70 pounds; it was then submerged in a tank of water. I weighed it on the 31st, and it weighed 74 pounds after it had been submerged 24 hours. I re-submerged it, and weighed it again on the 3rd of January, and it still weighed 74 pounds. Then I took it out and drained it, and put it over a small office heater where it would drain and be warm. On the 5th the block weighed 71 pounds. On the 10th it weighed 69¾ pounds. I then 7116
concluded it was fairly dry, or as dry as it would be in the atmosphere. This shows that it had lost but a quarter of a pound from the condition in which it was first received. I then broke it into pieces, one piece of which I could handle, which weighed 32 pounds. This I thoroughly dried, not using heat enough to drive off the water of hydration or crystalization.

Questioned by Mr. McCutchen.

I do not know how much heat I used; it was put over a little electric heater, and an iron box placed over that to concentrate the heat. I think it was above the boiling point part of the time. It remained over that several days. I think it was a constant heat. I did not try to regulate it. It was not over boiling point all of the time. It took some time for it to get up to boiling point. The current was off part of the time. I had it turned off at night. I first tried to put it over a couple of Bunsen burners, but the box I put over it extinguished the burners, and so I used an electric heater. On the 13th the piece weighed 32 pounds, which was the same weight. It lost nothing. It was 32 pounds both at the beginning and at the end of this roasting 7117
process.

There is no question but what the piece was as dry as concrete would ever get, until the water of hydration is driven off. I then shellaced it for the purpose of closing the pores, so that the error due to porosity would be eliminated. This is a perfectly proper process, and it is the only process that I know of that is proper to get at the specific gravity of this material. On the 17th I rigged a tank under the scale so that the 32 pound block could be weighed in air and in water. The board and the string which were used to hold the rock, and to support it across the scales, weighed 1¼ pounds; the greatest weight in the air was 33½ pounds. The tare 1¼ pounds made the net weight in air 32¼ pounds. With the additional shellac and errors in measurement, the weight of the block in air was 32¼ pounds. The gross weight in water was 19¼; the tare 1¼, making the net weight in water 18 pounds; so we have the weight in air 32¼ pounds, divided by the loss of weight in water 13¼ pounds, and that gives us a specific gravity of 2.26 instead of 2.42 apparent specific gravity found in that first experiment in the Bryant Street Yard. That represents the error in that experiment.

That corresponds to 141 pounds per cubic foot, plus the water that was left there, the water of hydration. I don't think I ever said 7118

that the material that went into a cubic foot of concrete weighed as low as 118. The weight which I figured for Crystal Springs Dam was 3500 lbs. of material. 3500 divided by 27 is 130.

Questioned by Mr. Hazen.

The weight in water was 18 pounds net, so there was 14¼ lbs. lost. The board and the string were not weighed in the water, except a very small portion of the string; the board was on the platform of
7119 the scales. The gross weight in air was 33½ lbs., which makes 2.26, and that multiplied by the weight of a cu. ft. of water taken at 62.4 lbs., is 141 lbs. per cubic foot. The shellac and possible errors in former weight amount to half a pound. I don't know what the specific gravity of the shellac is, but it is a very small amount as compared to the whole, and also when you consider that the nearest weight we could take on these scales was one-quarter of a pound, there is not any gross error in that shellac.

Mr. Hazen: If we assume that there is half a pound error in that, and the specific gravity is one, then we have 31¾ divided by 13¾, and the specific gravity would be 2.31, and the weight per cubic foot would be 144.

Mr. Dillman: I can't understand that; you will have to show me.

7120 Questioned by Master.

Mr. Dillman: There was one-quarter of a pound of shellac, and I raised to half a pound by reason of possible errors in preceding figures. There are errors in every measurement that I have ever taken. I didn't make that allowance because I thought it was proper. I think it is improper. I thought I had taken it, but I have not.

Mr. Hazen: Calculating it on one-quarter of a pound instead of half a pound would make it 32 divided by 14. The specific gravity would be 2.29, and the weight per cubic foot would be 142½.

7121 Mr. Dillman: There is not any such thing in practice as accurate measurements. You take measurements according to the needs of the case. Earth work, rock work, and concrete work are never measured exactly. The refinement necessary to be gone into to reasonable limits of possibilities would still contain errors in measurements. The error in this kind of work is insignificant compared to the gross errors by not considering the porosity of this material.

The purpose of my experiment was to show that 150 pounds did not go into this concrete in Crystal Springs. My experiment was to show that the alleged test of the weight of this concrete, when first made by Mr. Hazen and Mr. Metcalf, at the Bryant Street Yard, was grossly in error. I did not know what weight did go into the concrete, and I don't know yet. So far as the block we got there from the Crystal Springs Dam, 141 pounds went into a cu. ft. of concrete, but
7122 I don't know that that went all through there. When I got this laboratory, I also got some material from the Niles Cone, sand and gravel,

and I had some boxes made, in which we manufactured two blocks of concrete, one with a wet mix, and one with a dry mix. The dry mix was very thoroughly tamped into this box; the wet mix was shovel tamped into this box. All the material we could get into a cu. ft. of space there was 141 lbs. of sand, gravel and cement. The box was a cu. ft., and the materials were weighed dry, but were put into the box wet. The sand had a little moisture in it when it was weighed. I don't know whether the sand at Niles is loaded on to the cars very wet or not. If it started wet, it would dry out very much on the way to the Crystal Springs Dam. I did not count on any moisture in the sand or in the rock, that would have to be freighted from San Mateo to the Crystal Springs Dam, unless my weights assumed and constituted contained moisture.

My experiments did not eliminate the element of moisture en- 7123
tirely in the sand and gravel that was freighted, or would be freighted from San Mateo to Crystal Springs Dam. The gravel, I think, was fairly dry; the sand was damp. My experiment does not allow for moisture in the sand. I did not dry the sand out to ascertain what moisture there would be in a ton of sand. I don't know whether there would be considerable weight in a cu. ft. of sand. The weight of the materials that went into the concrete was not to exceed 145 lbs. at the outside. That is, the most compact concrete that is built of these materials cannot possibly exceed 145 pounds. There would be between 3 and 4 percent of moisture in the materials that went into the concrete. I don't intend to make any estimate on that. I don't know
which way the error would be. This experiment has eliminated the 7124
gross error which was introduced in the experiment by Mr. Hazen and Mr. Metcalf.

My experiment determines the weight of the materials that went into that concrete so far as the block of concrete represented the average of the Crystal Springs Dam. It is within a small percentage of error. It is less than 1%, I think. I said there might be a difference of possibly 3 or 4 percent of moisture, but the moisture that was in the sand was also in the sand to a more or less degree that I used and weighed. The sand that I used contained some moisture. It was not wholly dry, but I am not saying just how much it contained. I am not willing to hazard an opinion as to the percentage of moisture in
sand coming from Niles and used in the Crystal Springs Dam. The 7125
only way to tell would be to take that sand and dry it out, and then find out what it contains. My experiment does not leave you entirely in the air as to the weight of those materials. It eliminates the very gross error made in that experiment, and without taking into consideration the porosity of that stuff.

Mr. Searls: It checks exactly. He gets 141 lbs. either way.

Mr. Greene: Referring to page 5696 of the record, under the discussion as to weights, Mr. Searls interpreting Mr. Dillman's figures,

Dillman

says as follows: "It checks his own figures as to weight of the finished "product if he says 3200 lbs. to the cu. yd. of concrete. Mr. Hazen: "3200 lbs. per cu. yd. would be 118 lbs. per cu. ft., instead of 130— "which Mr. Dillman stated above, and Mr. Searls, that has not been "controverted."

Mr. Searls: You will find further on that Mr. Dillman increased his weights to 3500 pounds.

Mr. Greene: 118 was what was discussed at that time.

Hazen

Witness: ALLEN HAZEN for Plaintiff.

7126 After our experiment last fall, the large block on which the experiment was made was cut in several pieces, of which Mr. Dillman had one, and one of the large pieces was taken to a stone cutter, and he was directed to cut out a cubic foot. The stone cutter worked on it for some time, and cut a cube of material, but it was more than a cubic foot. He intended to trim it exactly to a foot, but he gave it up before he got it down, so that the dimensions over-run, but it is good, true shape, and can be measured exactly as it stands. That block has been standing in the shed out at the yard, under a good roof, and in a dry place, for perhaps six weeks, more or less. Last night a number of us went out, and Mr. Dillman measured this block, and we wrote down the figures that he measured. Mr. Metcalf weighed it, and the weight calculated from those figures is 150 lbs. to the cubic foot. The whole block, as we measured it originally, coming in from the rain, and without drying it, we measured 151 lbs. After six weeks' standing in a dry place on a shelf, and measuring a cube of it, in a way about which there cannot be any possible question, and which can be checked by anyone interested, it comes out 150 lbs. to the cubic foot. That material has not been calcined as Mr. Dillman's specimen was. I think it is as dry as concrete ordinarily ever gets, and it was as dry as I should ever think of having it when weighing it to determine that.

Questioned by Master.

I should expect that the heat that Mr. Dillman applied might drive off some of the water of crystalization. I don't know how I should
7127 determine that; I have not thought of it. It would take a good deal of heat to drive off enough water to make it disintegrate. The water of crystalization is something allied to a chemical combination closely. I think it might be correctly spoken of as a chemical combination, although a loose chemical combination.

Questioned by Mr. Searls.

The water of crystalization is taken up in the concrete to some extent in setting; about 30 lbs. to the barrel is taken up in setting. In all my calculations I allow for the water of crystalization which is taken up in setting. If they are taken into account, the weight is not

inaccurate. I allow for it by adding 30 lbs. to the barrel. If Mr. Dillman's experiment had proven up even a part of that water of crystalization, I do not think the result would have been more accurate then mine. If you want to determine the calcined dry material, with all the water exposure, obviously the concrete would have to be calcined, as Mr. Dillman has done, but that is an unusual procedure. I have never done it, and I never thought of doing it in this case. It is true there is some water in the concrete as dry as it is now, but it is a small amount; it is also true there is water in all the materials of 7128
the construction, and if it is taken into account on one side, it has to be taken into account equally on the other. The 7½ lbs. difference between the 142½ lbs., and the 150 lbs., might be due to water, although I find it very hard to believe that there is as much water in the concrete as that.

Questioned by Master.

I did not start out to find the amount of water in the material.

Mr. Dillman: I find the amount of water with the material I used, because I made two boxes of concrete, and it is the identical material I propose to use where all the material was carefully weighed. I think, probably, if there is any difference, that the material in a smaller experiment is a little dryer than the material that would go into a dam in bulk. I would not expect that difference to be more than 3 or 4 percent.

Questioned by Mr. McCutchen. 7129

Mr. Hazen: The percentage of moisture in sand and gravel coming wet from Niles is something that could only be determined by experience, because different sands differ a good deal in their capacity for holding water, but I should not be surprised if the sand from Niles carried 10% of water by weight at the start, less than that on arrival; it would lose in transit. The gravel would not carry as much.

Questioned by Master.

The primary discussion in this matter came on the weight of the concrete per cubic foot. In my estimates I figured on 150 lbs. per cu. ft., and that included 30 lbs. of hydration for each barrel of cement, and including that provided materials enough to make up that weight —and that is dry material; whatever the weight of the water would be in the sand would be added to that. I don't mean 30 lbs. of hydration in the 150 lbs. I mean 30 lbs. hydration per barrel of cement used. That figure I have from my own experience. I have tested that out.

Mr. Ellis: The sand and gravel that went into that manufactured 7130
block of cement were about the same dampness as ordinary construction materials. They were not dried out; they were the ordinary run of sand and gravel. The gravel was fairly dry, just the same as all Niles gravel is. The sand was more or less damp. It had come over from the rainy season. It was not damp enough to be objectionable,

but about the condition you would expect that sand to arrive in on any job. There was a sack of sand, and I should judge it was possibly 2 or 2½ cu. ft. of sand. It was a large sack of sand, and a sack of gravel.

Questioned by Mr. Greene.

Mr. Hazen: In my judgment, the weight of this block that was weighed out there corresponds pretty closely as the correction of the water of hydration in the cement, with the little correction for the water in the block as it now stands, and would be the larger correction for the probable water in the sand and ballast used. Taking them all into account, I think the material used would be somewhat greater than the weight of the finished block without any allowance for waste. I think there should be an allowance for waste, and that would still further increase it. I would suggest that that cubic foot that Mr.
7131 Dillman made be brought in here and put alongside of the cubic foot cut from the dam, and we can see just how they look side by side.

Mr. Ellis: I don't think a visual examination would mean anything at all, in so far as telling anything as to the strength or the integrity of the concrete.

Mr. Hazen: I think it would give us a very definite idea in this matter.

Mr. Dillman: Representatives of the Spring Valley were asked to be present at the manufacture of these blocks, but they were not present. Our material was fairly dry, and was tamped a good deal better than ordinary concrete is tamped when it is first-class concrete;
7132 there were three tampers and one shoveler. The wet concrete was merely shovel tamped in place, and contained within half a pound the same material as the other, the difference being in the amount of water used.

7133 DIRECT EXAMINATION BY MR. GREENE.

Mr. Hazen: College Hill Reservoir, page 224, differs from the University Mound in that it is built on a projecting spur of a hill, and was on an end of a ridge, or on a ridge where it falls off sharply at the end. A much more difficult place to build a reservoir than the site of the University Mound. There was some surplus excavation in this reservoir, but not nearly as much as in the University Mound, and the surplus was hauled off on the side of the lot, or rather, hauled up on the side of the lot.

The earth work consisted in taking off the top of the ridge, and building a dam with the earth on the lower ground on the two sides, and on the downhill side of the ridge, and on the one side it was all in excavation against the higher slope. The haul was not so long as at the University Mound, probably not averaging over 300 or 400 feet, but the slopes to be encountered would be much

greater; a good deal of the last part of the haul would be an uphill haul, and some of it a pretty steep uphill haul, because the reservoir is not very large, and the climbs would have to be made quickly.

I thought, from an inspection of the material in the neighborhood, that the material at College Hill was a stiffer, harder clay than at University Mound, and represented a greater difficulty in digging. The estimates of these reservoirs I made in all cases upon the
ground, taking the sheets out with me, and trying to think out 7134
how the ground originally looked, and where the surplus material would go, and where the material for construction would come from. I wrote prices opposite the items at that time in view of what I saw and found out in that way. I think that this earth work on the College Hill was more difficult than on the University Mound, and I estimated 10 cents a yard more for it. The puddle I estimated at $2.50 per cubic yard. I don't know where the clay came from; I was unable to locate any good puddle clay in the neighborhood, and I assume that that must have been brought in from the outside, and very likely it was quite a haul. In both of these reservoirs, and other reservoirs of the system, the work, so far as I could find out, was substantially tight. They are in daily use. It is not possible to shut them off to see if there is any leakage; in material like that of which these reservoirs were built, if there is any large amount of leakage it would probably show somewhere in the neighborhood. There are a few places where the ground is moist enough to make the grass show a little greener, but I was unable to find or hear of any substantial leakage, or indication of leakage from these reservoirs. The fact that they are tight is a very important consideration in deciding upon the character of the work, and upon the utility and value of it.

The other items I estimated in the same way as for the other reservoir, and they represented my judgment from the most part on the ground, and with the various structures before me. The buildings are agreed to, of course, the figures that I have have no signifi-
cance, because they are superseded by the agreed figures. 7135

The inlets and outlets, $8,000, are the structures for bringing the water into the reservoir, and for taking it out again. There are several structures at the College Hill Reservoir. There was an old system, and then a newer and a larger one added at a subsequent time, I think, in connection with additional piles.

The Honda Reservoir, page 229 of the schedule: I have here some photographs of this reservoir, marked 756-D, and 75-D, which show some of the conditions. These are dated June 2nd, 1904, but it is my understanding that they were reproduced on that date from photographs that were old at that time, and that were lost in the fire. I don't know what the original date was. I understand that Honda was a natural lake, and it was drained by cutting a

tunnel, or it would be cut and tunnel on one side, and probably by other drainage operations. There is quite a natural drainage area tributary to it, so that I should expect that a great deal of water would have to be taken care of right along during the construction of the bottom, and getting the foundations for the masonry walls. The excavation in the schedule is 104,600 cu. yds., not a very large quantity for a reservoir of this kind, and indicates that the basin was a natural one, and that this represents simply some trimming up of the sides to get a regular outline, and perhaps grading for
7136 the floor, though it seems to have been lined with cement; that is said to be sand, and I think it undoubtedly was sand excavation from an inspection of the neighborhood. I have estimated that at 75 cents per cu. yd., on the assumption that that was wet material, and that a great deal of draining work was necessary in connection with the excavation. I have had in mind work that has been carried out from time to time under my own direction, where excavation has been made in sand below the water level, in part, and where the work has ordinarily cost about $1 a cu. yard. I have not assumed that all of it would be as difficult as this, because some of it would be excavation on the sides, which would require an easier effort, and so I took 75 cents as representing the price for the whole of it. The solid rock excavation; I don't know what that represented, and I have put that in at $2. The gage board was a small item.

The puddle clay I estimated at $2.50 a cu. yd. I don't know where the clay came from, or where it could readily have been secured. I assume that it must have been hauled in from the outside, and probably from some distance.

The largest items of construction for this reservoir are masonry, and there are three kinds of masonry listed; concrete, brick work, and rubble, and some ashlar. To reproduce the brick work and ashler at the present time, in just the way that they are built, would cost a great deal of money. At the time that they were built brick
7137 was the normal, economical construction material for this kind of work, but at the present time, owing to the change in labor conditions, brick work is very much more expensive, relatively, than concrete, and it did not seem quite fair to me to rate this reservoir on what it would cost to reproduce the brick and ashlar today just as it was built, so I based this estimate on reproducing this masonry right through with concrete, because I think that is actually what would be done at the present time, or would have been done at any time in the period under discussion. Taking the quantities, and adding up the cu. yardage of the different materials, and converting the brick work into cu. yards, I have 20,476 cu. yards of masonry in the whole structure, and I estimated that at $10 a cu. yd., or $204,760.

The items of cement, plaster, and water-proofing I omit as being part of the masonry work. The brick work used to be plastered, commonly, but I should consider that part of the brick, if I estimated it as brick. I would expect the concrete to be applied so that it would not need plastering.

The figures as to the price of concrete as a whole, I presented some time ago, and they are covered by another schedule, and this was part of the work that was included in that discussion, and it applies to it. In my judgment, taking it right through, $10 a cu. yard is a fair price to estimate for the construction of that work, under the conditions at Honda. It is something of a haul for the materials. The work would call for quite a variety of forms. It is a fairly large piece of work at one place, that could be handled
with a central mixing plant, and without any very heavy expense 7138
for the transportation of the concrete after it was mixed. The method of estimating this as concrete is one that I have followed. I know some people don't approve of it, and perhaps I am not doing the company full justice in using it in this case, but it is what I have contended for when I am on the other side, and I allow just the same in this case.

My unit on the Crystal Springs Dam concrete was $9, and that is to be compared with this figure of $10 as far as they are comparable, but generally speaking, a structure like the Crystal Springs Dam could be built for somewhat less per cu. yd. than the walls and lining of a reservoir of this kind. I should not expect to get just the same price per cubic yard in the two cases.

Questioned by Master.

I omit water-proofing, because with concrete construction, which I should expect to do for $10, that would not be necessary.

Questioned by Mr. Searls.

The bottom of the reservoir ought to be surfaced; perhaps not just like a sidewalk, but in a way that would call for a corresponding amount of labor, and would cost as much. The walls, which would represent, I think, the greater part of the material, would not be surfaced in that way. They would be made against forms, and would be surfaced on the exposed top only.

Questioned by Mr. Greene.

The figure here includes all the masonry in the agreed schedule, and I am quite sure that it does include the dividing dam which crosses the reservoir. There is a further reason on that plastering
and water-proofing—a good deal of it is not in very good order, and 7139
if it were allowed, it would be marked off again in depreciation.

Mr. Dillman: My rate on the excavation is 30 cents.

Mr. Hazen: The forebay and the outlet system represents quite a little expense on Honda, because it was a difficult outlet following down the valley through what had been the natural dam that

formed the lake. That is estimated at prices that I thought were fair in going over the work.

There are some short tunnels. The one marked "Upper tunnel", line 38, is estimated at $35 per foot. This is a tunnel large enough so that two pipes could be laid in it, and it is also driven at a low level, where access to it was difficult.

The lower tunnel is a very small tunnel, and not large enough to lay pipes through; that was estimated at $22 per foot, which seems like a low figure for a tunnel. I think, as a matter of fact, that is quite a small tunnel.

There are a number of small items. The buildings are agreed upon, and my estimate has no significance as to them.

Questioned by Mr. Greene.

Structure 43, and structure 40 seem to be the largest items, and several of the other structures go with them, I think. They all represent a system of drainage. I think they properly should not
7140 be called sewers; it is a system of drainage to take the waters and the waste from the valleys above the reservoir around the reservoir, and discharge them into the valley below. Those structures are necessary to protect the quality of the water in the reservoir. The structures seem to be quite adequate for that. Mr. Elliott has since raised this reservoir so that the protection from any of these waters getting in is greater at the present time than it was at the date of this valuation. That shows the possibility of raising it, and giving it added protection. That was a wise move, and added to the capacity of the reservoir, which is also desirable. Drainage of this kind always has to be provided where a distributing reservoir is built in a natural valley where there is a population above it; also that is to be expected where the water company does not own the land above.

Questioned by Master.

I do not mean that the concrete is not waterproof. Referring to picture 756-D, you will see there are 2 valleys coming down to this reservoir from above; if the reservoir were simply built as a reservoir, and nothing was done, the water from those valleys would run into the reservoir. It is necessary to build this conduit to carry those flows around the reservoir and keep it out. That always has to be done with a reservoir built in such a location as that.

7141 (The two photographs marked 756-D, and 75-D, were offered, and put in the pamphlet with the other Merced pictures.)

Structure 48, a sewer tunnel, I omitted from my estimate. The reason that I estimated it was because the City was building, or had built a sewer which served the purpose of this old sewer tunnel. This estimate was made in the first place with reference to the proposed sale, and so I thought in connection with that that this old sewer tunnel probably had no value, and no claim had best be made

for it, but this actually was in use, and was necessary during most, or the whole of the period covered by these rate suits, and so I think, so far as these rates suits are concerned, I was in error in leaving it out, and it ought to be included. As I did not estimate it, I think that someone's else estimate should be added to my figure for that item.

The screen house, structure 55, serves to screen the water before it enters the reservoir. This was estimated in a similar way to the screen house at the University Mound. I think it is true here, also, as to some of the screens, that the brass wire has been replaced by cheaper material, and I think the allowance for depreciation will cover the difference there made on that.

These three reservoirs are the principal distributing reservoirs of the system. They are very well situated with reference to the territory to be served. They are near, and at suitable elevations. The University Mound supplies the low service; College Hill the intermediate service, and the Honda supplies the principal service of the city, and is a very important reservoir. The other reservoirs are scattered about, and serve special districts, or a small district, and in several cases, high districts. They serve local needs that 7142
would not be fully met by the principal reservoirs.

The first of these is the Potrero Heights Reservoir, on page 239. The first and largest item in the construction of this reservoir is the excavation. The reservoir was built nearly all in excavation in rock, and the hole was lined up, and the lining was carried as a wall for a certain distance above the top of the rock. The schedule shows loose rock, but from an inspection of the material on the sides of the hill where it is exposed, I should say that that is as hard and solid a rock as is encountered in the City of San Francisco. The excavation had to be made carefully, and at greater expense than would be ordinarily involved in excavation of this rock, in two respects: In the first place, the hole was lined up with concrete, and it was necessary to excavate carefully, and to shoot with small charges, to avoid shaking the rock outside the excavation to pieces, and making it unsuitable for the use that was to be made of it. The necessity of excavating in this way would add quite a little to the expense of handling this material. It was expensive for the second reason, that it was excavating the hole, and the material had to be hoisted out of it to be disposed of, instead of shoving it off the bank, or taking it out on grade, as might be done in some other excavation. That is estimated at $1.50 per cu. yd. The concrete lined wall is estimated at $12 per cu. yd. This is a circular structure, and is carried up as a lining in the rock, and extends as a wall above the top of the rock. The amount is comparatively small. That is estimated at $12 per cubic yard, and the bottom at $10 per cubic yard.

There is some brick in the bottom and the sides, which I have
7143 estimated at $25 and $30 per thousand. Also some cement plaster, which I presume goes with the brick work, at 5 cents per square foot. The rest of the items, mainly relate to the connections, and were estimated in the same way as for the other reservoirs. That applies to pages 239 and 240, including structure 11. The total cost to that point is $234,296. The rest of the estimate relates to a tank which was built afterwards, and which really is an independent little reservoir system by itself.

7144 AS TO THE POTRERO HEIGHTS RESERVOIR.

This is taken from the reports of the Spring Valley Water Co. to the City of San Francisco, and shows an expenditure in 1897 of $16,250,—in 1898, $3,825.28; total cost $20,075, made up as follows:

Labor	$10,099
Cement	3,207
Grading	2,609
Float	125
Not classified	4,035
	$20,075

The cost of labor at the present time would be something like 9% greater than in 1897, but improved appliances would permit a reduction in the number of men. The increase would be large, but not in direct ratio. Adding 50% of the labor cost, or $5,050, makes the total cost brought up to date $25,125.

This reservoir was constructed entirely on excavation, and the excavation is the largest item of the cost of construction. This excavation is reported in the agreed schedule as loose rock, but from my own inspection it seems that the rocks are loose for a slight distance on the surface only. Other excavations in the neighborhood at the time of inspection showed the rock to be solid and hard for a short distance below the surface, and this actual condition was taken in estimating the price per cubic yard.

The cost of construction is also increased because the reservoir is at the top of a sharp hill, with bad roads, and the cost of delivering tools and supplies at the site would be greatly increased over the ordinary delivery cost at a corresponding position.

7145 It appears from this that the cost of this reservoir was $20,075. It was built at a time when labor was very much cheaper than at present. I have not attempted to bring it up to date in a precise way, but in a general way it would certainly cost a great deal more to build now than it did cost to build at the time when it was built.

It may be that the reported cost includes some overhead, but I have no information on that point.

The wood tank, represented by structures 12 to 18, inclusive, is estimated $1,151, which was my understanding of the actual cost without overhead. The keeper's dwelling is an agreed figure. Mr. Elliott tells me that the cost of $1,151 includes structures 12 to 16, on page 241, and does not include structures 17 and 18, as I assumed it to do, and to that extent my estimate is in error, and too low.

The Lombard Street Reservoir, page 244, is on the top of a high, sharp hill. It was necessary to bring in material from off the immediate site to build it. It was a sharp, uphill haul for that. Too steep to take it up by scrapers. It would have to be hoisted in some way. The unit prices are raised somewhat because of these conditions. I have for the earth excavation on the site 50 cents per cu. yd.; loose rock, $1.25; for the embankment, 25 cents per cu. yd., which is an addition to the 50 cents, making 75 cents altogether for taking the material on the lot, and making a dam of it; for placing the loose rock, 25 cents; for the borrow, 85 cents, which 7146
with the 25 cents in the embankment makes $1.10 for getting the material on to the site, hoisting it up, and making a dam of it.

The brick lining on the bottom I have estimated at $22 a thousand, and $30 for the lining of the slopes. I think it is very doubtful if the brick work could be built as it actually is for these prices. They would correspond to $11 and $15 per cu. yd. for concrete. I had that in mind as a limiting condition in making those estimates.

The cement plaster is estimated at 5 cents; it is a small item. There is a rubble wall which is not strictly a part of the reservoir, but which is necessary along the street to hold up the bank on top of which the reservoir is; that is a very good grade of rubble masonry. I estimate it, and some plaster on it, and some other minor items, at $6 per cubic yard. The concrete curb, gutter and catch basins are estimated at $12 per cubic yard. The asphalt coating at 3 cents a sq. foot, and on the slopes 1½ cents a sq. foot. The other items are small.

There is quite an item for cultivation of this reservoir. A good deal of expense was incurred in bringing on good soil. This is estimated as to the greatest quantity at $2 per cu. yd., with 75 cents a cu. yd. for trimming and disposing of the material taken off; then the planting is added. The grounds have been parked, and present an attractive appearance, which is desirable in the residential section where this reservoir is located. The inlet and outlet systems are estimated as for the other reservoirs. I think the tunnel is not a true tunnel, but an open cut.

To explain my unit at $22 for lining the brick bottoms, and $30 for lining the brick slopes: It is more expensive to place either 7147
brick or concrete on slopes than it is on the bottom. The brick

work on this reservoir is in fair condition; it seems to be a very excellent piece of work, and I took that into account in making the estimate.

The Francisco Street Reservoir, page 247: I estimated for earth excavation 40 cents; then for placing it in embankment, 25 cents, making 65 cents altogether. For loose rock, $1.25 in excavation. This reservoir was puddled, and the puddle is estimated at $2.50 a cubic yard. The concrete is estimated at $12 per cu. yd.; some brick work—brick walls—at $22 per thousand, which corresponds to $11 per cu. yd. for concrete. Those walls represent relatively simple construction, and are estimated at $1 less per cu. yd. than the paving. The brick slopes—only a small amount—I estimate at $30 per thousand, and in another section the bricks on the bottom are estimated at $22 per thousand again. Plaster I estimate at 5 cents. Then follows some small items, and also the inlet and outlet pipe systems. The keeper's residence has been agreed to.

I use a unit of $12 for my concrete here, as against $10 at Lake Honda, because this is a much smaller piece of work, and a different location. In my judgment this was a fair price under the conditions existing here. The Honda construction was quite a heavy wall, and quite a large mass of concrete in one place, and it makes it possible to do the work for a smaller price per cubic yard.

Questioned by Mr. Searls.

I think the haul would be shorter here; on the other hand, it would be quite a little climb, quite a steep grade. I expect it would be possible at the present time to go up there with motor trucks,
7148 but we are a little in doubt as to whether motor trucks were available in 1907 for this work. I didn't make any specific assumptions for using motor trucks for the hauling on my city work. I am in the habit of doing this work by contract, and letting the contractor do it the cheapest way he can. If motor trucks were available, I am perfectly willing to assume that they were used in any transportation that was to be done; if they were not available in 1907, and the other earlier years, it does not seem to me the assumption ought to be made that the prices of hauling would be covered by prices that could be secured at the present time.

Questioned by Mr. Greene.

The $1.25 for loose rock was my estimate as to the cost of making that excavation. The conditions would be somewhat like those I described at the Potrero Heights Reservoir. That is to say it could not be shot so hard as to leave the adjoining rock that was to be used as a basis badly broken or irregular; on the other hand, I don't presume, in this case, that it was necessary to hoist it out of a hole. I presume they were able to get it out without any special difficulty in delivery, and possibly deposit it on the lower part of the same lot.

The Francisco Reservoir is absolutely necessary to the operation of the system at the present time, but at the same time it is a reservoir that dates back to the earlier and different conditions, and it is not ordinarily carried full at the present time. In the development of the system, probably, some other disposition will be made of it, so this relates more to depreciation than to the cost of reproduction, but it really is in a somewhat different position from the first three reservoirs we considered.

We come next to the tanks. I have here a little statistical information as to three tanks, which I would like to read in at this point. It is as follows: 7149

Spring Valley Water Company
February 14, 1916

STAND PIPE DATE

(Copied from Page A-149, Allen Hazen's Note Book, May 1914)

	Clarendon Heights	Presidio Heights	Clay Street
Diameter	80	60	60
Height	15	35	11
Capacity, gallons	565,000	740,000	233,000
Date	1895	1903	1885
Material	Steel	Steel	Steel
Weight, pounds	124,377	205,961	65,527
Weight per 1,000 gallons capacity	220	275	280
Foundation, cubic yards	208	797	182
Cu. yds. per 1,000 gallons	0.37	1.07	0.78
Depth over area of tank	1.12	7.60	1.74
Plates, thickness	¼	⅜	¼
Stress on plate	12,500	14,500	6,800
Stress on plate, 72% between rivets	17,300	20,000	9,600

NOTE: Presidio Heights tank in 1903 cost $12,490 or 6.05 cents per lb. The costs of the earlier tanks are not known.

Allow cents per pound	6	6	7½
Amount	$7,500	$12,300	$4,900
Cover @ 25c per sq. foot	1,260	700	700

These tanks are smaller reservoirs built on the tops of hills where it was not possible to get open reservoirs for the service and when this type of construction is more advantageous.

The Clarendon Heights Tank is set forth on page 250. The excavation I estimated at 50 cents a cu. yd.; concrete base at $10 per cu. yd.; the steel work at 6 cents per lb., erected complete. That price I reached in this way: In the East 5 cents a pound for stand-pipes complete, erected, is about a normal price. The extra freight to San 7150

Francisco would make, perhaps, six-tenths of a cent per lb., and the extra cost of erection would make about four-tenths of a cent per lb., and so I allow about a cent extra. In connection with that I have the information that the actual cost of the Presidio Heights Tank was in 1903 $12,490, which amounted to 6.5 cents per lb., and so checks my figure. While 1903 is before the date under discussion, it is not so long before it, and there was probably no very radical change in conditions during that interval.

Questioned by Mr. Searls.

This price of steel I take as an average price.

The covers for these tanks I estimated at 25 cents per sq. ft., uniformly, regardless of the variations in the way they are built. These represent roofs. They are supported by some structural steel work in the interior, which was put up to help brace the tank, and which also helps carry the roof. The different tanks vary considerably in that respect, and I ignored those differences, and took what I considered a fair, average price for the coverings.

The fence around this tank is a very substantial one, and the estimate is $796.

The Clay Street Tank is given on page 252. That is made of
7151 wrought iron plates. The excavation was slight; the concrete is estimated at $10 per cu. yd., the tank at 7½ cents a lb., instead of 6 cents for the steel, an advance of 1½ cents a lb., because of its being wrought iron. In making that estimate, I assumed that the plates were of the same excellent quality of wrought iron that they used in the pipes built at that time. The 1½ cents I regarded as an approximate differential representing that. If it were assumed that it were built of ordinary tank plate, the increase above steel would be somewhat less than that, but this is based on the assumption that the metal is equal to the average of the pipe.

The Presidio Heights Tank is shown on page 255. The foundation is estimated at $1 per cubic yard. I cannot remember why I made these variations in the cost of excavation; I made them all on the ground, and with reference to the conditions as I saw them. That was a year and a half ago. I have not any record of it, and I cannot always remember just why I made the differences, but they represented my best judgment and inspection at the time. The concrete work is taken at $10, but there is some extra concrete here, a large part of it, and that is estimated at $9. The tank is estimated at 6 cents a lb., and the cover at 25 cents a sq. ft., and there is the railing, and inlet and outlet systems. The total comes to $23,925.

Questioned by Mr. Searls.

7152 I think, with reference to the retaining wall on Clay Street, which I give at $12, that I thought from the looks of it at that time that it would cost that much to build it. It would evidently call for forms, and a different construction from placing the concrete on the founda-

tion, and leveling it up as a basis for a tank. Mr. Sharon handed me a memoranda from the books of the company, showing the actual cost of the Presidio Tank to be $28,406, which is about $4,500 more than my estimate.

Questioned by Mr. Greene.

That was built in 1902 and 1903, and the last payment was in 1904. I am unable to state certainly that this covers just the work covered by these structures. That is the danger of these old records; they paid for the work that was built at the time; in making up this inventory there is always danger that the classification of the material for the purpose of the inventory is different from the classification as it was built. All these old records I have a little doubt about on the exact classification.

The understanding that I have from talking with Mr. Dockweiler 7154
and Mr. Lawrence with respect to tunnels is that the figures in the agreed inventory are to be accepted as the section that might be reasonably or probably would be specified if bids were to be obtained for driving the tunnels on a yardage basis, and that all excavation outside those lines would be at the contractor's risk and expense. In other words, on that basis, the cost of overbreakage would have to be reflected in the units.

Mr. Metcalf: That is practically in accord with what I said yesterday.

Witness: Geo. L. Dillman for Defendants. 7156

CROSS EXAMINATION BY MR. McCUTCHEN. Dillman

I don't know as there is any difference between the block I made and this block that came from the Crystal Springs Dam. The block that I made had more dry material per cubic foot than the Spring Valley Dam block that I tested, as I know, because I weighed the material that went into my block before I added water. There were 141 lbs., and there were only 141 lbs. in the Crystal Springs block per cubic foot, with whatever water was retained after that dried out. I don't know how dry it is now.

When I said that no concrete ever weighed 150 lbs., except with a considerable proportion of plums, I meant the dry materials of concrete. The materials of which the concrete was made, without the 7157
water does not weigh 150 lbs. per cubic foot. I meant that the materials that went to make the concrete, excluding the water, did not weigh 150 lbs. per cubic foot, because we were getting up the dry materials in concrete. If you take the weight of water, the concrete saturated will weigh 150 lbs. I do not doubt, but dry concrete, without a great deal of plums, must have plums heavier than the average of

the other materials to ever weigh 150 lbs. to the cubic foot, and I say so now more firmly after these tests. I don't know what the weight of material per cubic foot was that went into this concrete. My opinion is it was something less than 140 lbs., probably between 138 and 140 pounds.

7158 I don't know what the concrete weighed when it was finished; it is 3,500 lbs., plus whatever water was retained. I don't know what it would weigh, and I don't think it is material to this question at all, and I have not started to investigate it. The answer as to what the finished concrete did weigh into which I put the 3,500 lbs. of sand, gravel, and cement, is not material to my evidence, or to my conclusions.

It is not my opinion that the sample taken from the Spring Valley Dam, and the one which I had made under my supervision, if they
7159 were put side by side, would look substantially alike. One is a piece of concrete, all sides of which are trimmed down and polished, and the other is rough concrete, such as is laid against the forms. If I were to take either block of my concrete and grind the faces down, the resemblance woud be somewhat similar, but the rock in the Spring Valley concrete shows an angular form; it is crushed rock, while the rock in my concrete would be more curved, because it is made of gravel. My rock shows an angular form on the faces that have been thinned down. The porosity is not much visible to the naked eye. The porosity that I speak of is a minute porosity, and it permeates the whole structure of both pieces, I think. You could not detect the porosity in either one of them with the naked eye. I do not think any expert, looking at those two pieces, would be able to tell without difficulty that one had more porosity than the other. The two pieces of concrete
7160 would look very different. One has entirely finished and polished faces, and the other has entirely rough faces.

I have two or three pieces with irregular surfaces of the concrete that came from the Spring Valley Dam that have not been shellaced. If I were to put those pieces with the rough faces by the side of my piece, I don't think I could tell which had the greater porosity. I think my pieces were compacted as much as those were in the Spring Valley Dam, but I don't think an inspection would indicate that. Possibly under the microscope you could see a little difference, if there is a difference, but I don't know which way it is. I don't know which has the most porosity. I don't think my piece is more porous than the sample from the dam; it is well compacted concrete.

7161 I added 300 lbs. to my estimate of costs of this concrete on account of the error that was made by the rock and sand man, making 3,500 lbs. of dry material per yard of concrete. I don't remember what change I made in dollars and cents. I did not make any, as a matter of fact, I simply reduced the profit. If I allow 3,200 lbs. in my original estimate, and the concrete weighs 4,050 lbs., there would be a

shortage of about 800 lbs. on each yard of cement, barring the amount of water added. It takes practically 270 to 300 lbs. of water to make concrete, per barrel. I don't know how much of it goes out, but I think 7162
some of it evaporates. I am satisfied that the water is not all drained out of this block that we looked at last night, nor evaporated. Not more than half of it has evaporated so far out of the blocks the last time I weighed them, and on the 17th of January the dry mix weighed $147\frac{1}{2}$, and the wet mix weighed $146\frac{1}{2}$. The weight of the Spring Valley block, according to the last measurements, appeared to be 150 lbs., or a little under; so it looks as though the wet mix weighs $3\frac{1}{2}$ lbs. less per cu. ft. than the Spring Valley mixture. I first weighed 7163
my wet mix immediately after it was made, and one block weighed 150 lbs., and the other $150\frac{1}{2}$. The wet mix weighed $150\frac{1}{2}$, and it has lost 4 lbs., and the other one has lost $3\frac{1}{2}$ lbs. I don't know whether the Spring Valley block has as much moisture or not in it as my wet mixture now has, and I do not account for the fact that it seems to weigh $3\frac{1}{2}$ lbs. less to the cu. ft. I would propose, if they want to use that block, that they proceed in the proper manner to get its specific gravity, and then there would be something to conclude on. The method of making the experiment is less accurate with the block that we measured last night than with the block that we weighed in and 7164
out of water. I have less doubt about the weight of that block than about the measurements, but I have some doubt about the actual weight per cubic foot.

To get at the weight of dry material there, I would dry it out and then weigh it. I don't think this wet mixture of mine is dry. The weight of mine includes the weight of known dry material, 141 lbs., plus water, and there is one in one case $6\frac{1}{2}$, and the other $5\frac{1}{2}$ lbs. of water in mine yet, and it has been drying for quite a while, and I do not doubt but what it has been drying as long, or longer than the Spring Valley piece. I don't know whether my wet mixture is dryer than the Spring Valley piece or not. I have no information on the subject. I think, very likely, that there is probably as much water in the block taken from the Crystal Springs Dam now as in my wet mixture now. I don't know what the actual fact is. The sample which 7165
I had to heat was not subjected to a heat of more than 500 degrees all the time. I think the greatest heat that could be generated with the apparatus that I had would be about 120 or 130 degrees centigrade. It is above boiling point. The box which we put over the electric heater was an iron box with a tap in the bottom and on top, and into that one day I inserted a thermometer; I don't remember what it registered, but I do know that it was not an excessive heat. The material was not calcined; it was not above the boiling point of water; and in my belief it was not high enough to destroy the hydration; it did not destroy the appearance of the concrete; it did not rupture anything. I was very anxious not to subject it to such a heat as would do that. 7166

I subjected it to that heat for two days, with the juice turned off at night.

I have now allowed sufficient material, taking 3,000 lbs. of rock and sand, and 500 lbs. of cement. That will make a good concrete. If it does not make it, the material will be made good by the Niles Gravel Co., and I don't think that will cost anyone anything. If you did not have the Niles gravel man, I should still get the same guarantee from the Rhodes-Jamison people, and from the Grant Gravel Co., of Livermore Valley. I am a little in doubt as to whether 3,500 lbs. of the materials I have named will make a yard of concrete such as is in that dam. If it is all as good as the piece that was shipped out and brought up here, I rather think I would be shy of some material, prob-
7167 ably 200 or 300 lbs. a cubic yard shy. I would not say more than 300 lbs., but it might be that much. If it figures that I would possibly be shy 23,700 tons of material needed to construct the dam, it is right; I did not figure it. I would not be shy 300 times 158,000 cubic yards in pound on the materials necessary to build such a structure as that, nor would I be shy 23,700 tons; I would not be shy at all. I would have every pound of material necessary to build that dam in these figures that I have given in the way that I have proposed to weigh the material.

When I said a moment ago that I would probably be 200 or 300 lbs. per cubic yard shy, I meant what I said, namely, that I would ex-
7168 pect, if it were a fact, to have that made good by the material man. I am not shy on cement; I am not shy on material. I said a while ago I would probably be shy 200 or 300 lbs., and somebody in the building of that dam would be 23,000 and odd tons, or whatever it figures, shy, but you would not have to buy the material, or pay for freighting it; you will get it in the original purchase. This stuff is not weighed on the cars or in the trucks. It is measured, and measured liberally, both on the cars and in the cuts. I think you would get that 23,000 additional tons transported to San Mateo, and from San Mateo to the dam, without any additional expense. It would not cost any more for labor putting that additional material in the dam. I believe that I could purchase that material for 60 or 65 cents at the outside per ton, landed at San Mateo, and that alone makes more than the difference in weight. I propose to leave my estimate as it is. I can stand
7169 on my estimate of the cost per cubic yard. The cubic yardage is a matter of inventory. These analyses of concrete are made subsequent to my estimate. I stand to my estimate of materials as modified here necessary to make a cubic yard of concrete.

My analysis of this concrete was made subsequent to my estimate. I know more about the cost of concrete in place than I do about a great many details that I have been discussing here. There is no reason in my mind to change that estimate. I believe it is full and complete, and I believe that receiving bids for putting that concrete in place,

irrespective of what it weighs, or how much water it takes, or how much cement it takes, that bids would be put in here by responsible companies, and hardly any of them will bid over $6.90 per cubic yard for that material in place. It would not be crushed rock concrete, unless I chose to change my mind on an examination of quarry sites, and I might displace the gravel with crushed rock near the site if I thought that was the best thing to do. It would be just as good concrete as there is there now, and as heavy. I have no reason to think that it 7170
would weigh less per cubic foot than the concrete that is there now. It would be well put in.

Questioned by Mr. Searls.

Weight is not the sole criterion for good concrete. The uniformity is of much more importance than the weight in a good mixture. The weight could be put in there without being properly mixed in such a way that no matter how much it was tamped, or how much it was compacted, that still would not be good concrete.

CROSS EXAMINATION BY MR. MCCUTCHEN.

Taking a piece of concrete that will weigh 140 lbs. per cubic foot, and another piece of concrete which is a fair sample, that will weigh 148 lbs. per cubic foot, my opinion is that the heavier concrete would be the best, but it might be the worst. I think that if proper methods of construction were employed, that the heavier concrete would be the best.

Mr. Dockweiler: The statement which Mr. Hazen made in rela- 7171
tion to the understanding that he has with relation to the figures in the agreed inventory with respect to tunnels is a fair statement, as it appears on page 7154 of the transcript.

I assumed that the tunnel would be driven so much per foot, and I divided that cost per foot by the yardage stipulated in the schedule per lineal foot, and thus determined my price of driving per cubic yard, so that my price of driving per lineal foot automatically cares for the overbreak, whatever that may be. I do not allow any fixed percentage for overbreak.

Witness: G. A. Elliott for Plaintiff. 7172

DIRECT EXAMINATION BY MR. GREENE. Elliott

Elliott's appraisal of the city reservoirs introduced and marked "Plaintiff's Exhibit 144".

University Mound Reservoir: On the excavation I used a unit of 40 cents, and compacted fill 25 cents, making the total per yard in the fill 65 cents. This figure is based upon experience and observation that I have had heretofore. I have in mind particularly the following works: The cost of the shovel work, and so on, at Calaveras; then my

personal experience on the Deer Creek Forebay, which forebay is a small reservoir at the head of a pipe line, and was made by excavating earth from the center of the basin, hauling it and depositing it in layers, rolling and wetting it. I was on that work myself. That cost 70 cents a cubic yard, as compared with my estimate here of 65 cents.

Questioned by Master.

The Deer Creek power house was within about 12 miles of Nevada City. It is one of the projects of the Pacific Gas & Electric Co., and was built in 1907 and 1908. The University Mound Reservoir, in my opinion, is a steam shovel job.

Mr. Hazen: I assumed it as a steam shovel job.

7173

DIRECT EXAMINATION BY MR. GREENE.

Mr. Elliott: The cost of the Calaveras work up to the end of November was 54.3 cents per yard, of which 12 cents per yard was for powder; that would leave about 42.3 cents for excavation and hauling at Calaveras. I do not consider that we placed the material at Calaveras as it would be placed in these city reservoirs. The material is hauled over and dumped at any convenient place; it is not spread, rolled, or anything of that sort, so that for the steam shovel work that we would do out here, the corresponding Calaveras figure was about 42 cents; that figure of 42 cents contains nothing for equipment, or depreciation on equipment.

The other instance that I was going to mention in connection with this was the Lake Arthur Dam. I was present at the construction of a part of the dam, and visited it several times. That cost 72.2 cents per cubic yard in place.

Questioned by Master.

Lake Arthur is about 6 or 7 miles above Auburn, right on the State Highway, and close to the railroad. That was scraper work.

Questioned by Mr. Searls.

These figures were from Mr. Martin, and I have had them for some years. I got them the year the dam was built.

DIRECT EXAMINATION BY MR. GREENE.

The Drum Forebay, 1912 and 1913: I spent in all probably 2 weeks at Drum, while that work was going on, and observed it;
7174 that was not entirely a steam shovel job. It was principally done by scrapers and wagons. That cost 74½ cents a yard for the fill alone.

The next item is macadam bottom 10 inches thick, 24,000 sq. yds., which I have estimated at 56 cents a sq. yard. I have in mind in connection with that item some work which we recently did in the vicinity of Lake Honda in spreading macadam and not rolling it. It cost us at that point 51 cents per sq. yd., 10 inches thick, without rolling or wetting. Concrete slopes I have estimated at $10 per cu. yard. All of my concrete work in general I have put in at

$10 a cu. yard, and in doing that I had in mind the cost of work which was done here in San Francisco, but this does not amount to very much in the mass at any one particular place, and I had in mind particularly the cost of concrete work of similar character at Calaveras. I have also in mind a recent contract, which probably it is not fair to use on this sort of work, because times were pretty dull, and the contractor wanted a job pretty badly. The amount of that was in the neighborhood of $10 per cu. yard. The asphalt paving on the crest is a small item, and I have used 20 cents for that. The asphalt, felt, and waterproofing on the slopes, 1½ cents per sq. ft.; on the bottom 1 cent. I think possibly I am a little low on those two items.

Referring to items 7 to 13, pages 218 and 219: One of the larger items is the pipe inlet system, which consists of the inlet works into the reservoir, with the exception of the screen house. It amounts in my schedule to $4,341. The wrought iron pipe, 264 feet long, I put in at $14 a foot. That is by far the largest single item.

The brick masonry in the forebay outlet system seems to be the 7175
largest item. Throughout all the San Francisco work for brick masonry, I have used for straight work $30 a thousand in place. For open arch brick work—by "open" I mean outside as distinguished from lining a tunnel—$35, and slopes at $35, short tunnels at $40, and long tunnels at $45 a thousand in place.

These figures were derived principally from work which I did in 1911 in connection with boiler foundations, and while I realize that it is not directly comparable with the class of work that is done in tunnels and in reservoirs, still I had that in mind when I made these figures. In that work at Central Pump, the common brick in place cost $27 a thousand, and the red pressed brick in place cost $65 a thousand. The hard-burned brick cost $30 a thousand.

Questioned by Master.

I do not know the difference between common brick and hard-burned brick in manufacture, but the result is that the brick is more dense, and not so porous. The brick masonry on this outlet system, item No. 2, went in at $30, and the arch at $35 a thousand.

Questioned by Mr. Searls.

The boiler foundation costs were common brick $27; red pressed brick $65. That is vitrified brick, but I have not estimated any of that with this, and I do not think there is any of that sort of brick anywhere else in the system, excepting out there.

Referring to the tunnel outlet system, at page 219, Structure 7176
No. 11: I understood Mr. Hazen to say this morning that he had considered that as an open cut. I did not. I took it just as it was in the inventory. In this tunnel work I have used a cubic yard figure for the tunnel, and this particular case being earth, I have used $7.50 per cu. yd., but the brick work, and any other lining, is in addi-

tion to that. That was based on an experience that I had in Calaveras in running several short tunnels 200 or 300 feet long. They will run, some of them, in material, very much the same as this, and the one that I have in mind at the present time cost us $7.53 a cu. yd. for taking out the material.

Questioned by Mr. Searls.

Some of these tunnels were timbered, and some were not. I could not say at present whether that $7.53 includes timbering, but I will look it up.

Questioned by Master.

Mr. Hazen: I think the estimate on the screens was based on
7177 brass mesh throughout. The screens that I saw and examined were brass, and some time later I discovered that the brass had been wearing, and was being replaced with cheaper material. I have not taken that into account. I have made quite a heavy allowance for depreciation on these screens, and I think that would cover the replacing the brass with other material.

Mr. Elliott: When this inventory was made up in 1913, the screens were in the condition as described here. The brass screen is just a support for the cheese cloth, and some of these brass screens have worn out, and they have now just strips of wire across them. I do not suppose it would make a difference of $200 or $300 in the entire estimate for the change in the screens.

College Hill Reservoir: I have used the same figure for excavation, but the embankment I have put in at 20 cents, and the reason for my change there was that I considered the transporting and placing would be easier than at University Mound. The haul is not nearly so long, and I do not consider the height of the bank is any great bar to the work of the mule. The grade would be comparatively easy, so in the embankment I allowed 5 cents for the difference in the difficulty of placing.

Questioned by Master.

I did not have Mr. Hazen's figures before me in making these figures. We made the thing simultaneously, but I have seen his figures. I think Mr. Hazen has somewhat more than I have. When I put 40 cents for excavation, and 25 cents for compacted fill, in the University Mound Reservoir, which was the same as Mr. Hazen's
7178 figure, I do not know whether I knew that he had the same figure or not. I did not know it when I made the figures, but I knew it was 40 and 25 before I came into court. I was absolutely not influenced by knowledge of his figures when I reached these figures of 40 and 25. These figures are based on what I think it could be done for.

The clay puddle is put in at $2.50, and I did that on the assumption that I should have to get clay in San Mateo County. I have been unable to find any deposit of clay in San Francisco that

I could use. If there is any in town, that would make a change in that figure, but so far as I know, it would have to be brought from San Mateo County.

Questioned by Master.

They do find small deposits of clay in the streets. We find a few yards at a time that is pure clay that we are able to take and use in making lead joints in the pipe, but we do not find any considerable deposits, excepting in the streets that way; you would have to pick it up here and there. For instance the amount here is about 8,000 yards. I could get 50 or 100 yards in a good many places, but I don't know of any place that I could get 8,000 yards.

College Hill is at Appleton Avenue and West Avenue, Bernal 7179
Heights, about a block off Mission Street. The rip rap I have put in at 10 cents a sq. foot. The rip rap on the Lake Valley Reservoir was what I had in mind particularly there. I was there for a week while that rip rap was being quarried and placed, and it cost 90 cents a sq. yard for quarrying, $2.70 a cu. yard for quarrying and placing.

The next item is structure 10, page 225, inlet system, of which the principal amount is $2,566 for 30-inch wrought iron pipe, which I have put in at $10.69 a foot.

The next item is the piping in the new forebay, page 227. The 7180
only new unit cost appearing there seems to be the rock excavation, which I have put in at $3. I have assumed for that rock excavation that it will all be hand work. It doesn't amount to much. I have put in the concrete at $10; the 30-inch cast-iron pipe at $8.13.

In the Lake Honda Reservoir I have taken the excavation as wet excavation, and put a price of 75 cents on it. I had in mind the excavation of the foundation for the tank at the Central Pumping Station, which was also wet excavation. There was practically no haul there. We did that with scrapers entirely, and it cost 58 cents a cu. yard. It was simply hauled out of the excavation, and dumped within 20 or 30 feet of that location. The difference between the 56 cents and the 75 cents I have put it for the entire removal of the earth; it would have to be hauled for some distance, perhaps a mile, to get it out of the valley.

The solid rock excavation is a very small amount. All of the concrete I have taken at $10 a cu. yd. in place. The puddle is the same, and the rubble masonry I have taken at $8 per cu. yd. The brick masonry follows the schedule I have given before. The ashlar masonry I put in at $17 a cu. yd. The plaster at 5 cents. The asphalt coating has entirely disappeared, so it does not matter par- 7181
ticularly about that. That will depreciate out. It is here at 3 cents a square foot.

The forebay outlet system—$5,900—the principal constituents of that item are the brick work at $35 per thousand, the upper tunnel

structure 19, page 230, amounting roughly to $4,600. I have used $8 a lineal foot for excavation, and the concrete lining is $12, and the brick lining $45. The same prices were used on the lower tunnel. I have a price of $11,305 for the sewer tunnel. That was a tunnel built to contain a drain from what is known as the waste pond, just below Lake Honda. In 1914 it was replaced by a sewer, which was built higher up, and that also was covered. It is out of use at the present time.

For the other sewers, the items beginning at the top of the page, the first one is $6,600; the forebay $1300; the 4 ft. 6 in. sewer $18,272; and then the sewer tunnel referred to before $11,305. Those are the principal items. On page 237, the 12-inch cast-iron pipe sewer is $4,824. That is regular class B cast-iron pipe construction. At University Mound I used for the screens a price of $15 each. We had to make up a couple not long ago, and they cost us about $22 apiece; it was a matter of only making two of them, and I figured
7182 that by making all of them we could save considerable.

Mr. Hazen: Referring to the 4 ft. 6 in. sewer, page 236, on which Mr. Elliott's excavation figure is 85 cents a cu. yd., and mine is $1.20: As I remember it, that is a sewer under the road along the reservoir. If I am right in my recollection, that is rather a difficult place to build a structure under the road, and I should not estimate the excavation and backfill for less than the amount I put on
7183 it. I followed every one of those out on the ground and checked off the schedules, and I made the prices for the most part as I did that, and with reference to the conditions. I don't think I made a substantial difference, unless there was some condition to call for it.

DIRECT EXAMINATION BY MR. GREENE.

Mr. Elliott: Potrero Heights Reservoir: The loose rock excavation I have in at $1.50. I have in mind similar excavation at Calaveras, and this corresponds to our cut-off trench work up there, which would be easier to excavate than the Potrero Heights Reservoir for the reason that you do not have to go down into it to take out the material; you can wheel it out on a level grade at either end. Up there, under the condition we are working in, it cost us about $1.25 a cu. yd. to get rid of that material. In my judgment this $1.50 would be about correct. I would not use a steam shovel, as it is too small; there is not enough work here.

The brick lining and concrete lining were put in at the usual
7184 price of $10, $30 and $35. For the cement plaster on the slopes I have allowed 1 cent more per sq. foot than on the bottom. The outlet tunnel was a comparatively short tunnel, and I put it in at $7.50 a cu. yd., and $40 for brick work.

Referring to pages 241 and 242; page 241 was the one discussed this morning, when Mr. Hazen said he had the original cost.

That was for materials in place only. Page 242 is additional, and I have $3,000 for both of those pages. I think that figure is not correct, and I would like permission to correct that a little later on. That $3,000 represents cost of certain work we did up there in that particular year, but it included some work that has been valued in the city pipe system, so it is too large.*

Lombard Street Reservoir, page 244; the earth excavation I have placed at 40 cents; loose rock at $1; the earth embankment at 25 cents; and the loose rock embankment at 50 cents; the earth borrow at 75 cents; the brick and concrete work at $10, $30 and $35, with the exception of a concrete curb and gutter which had to be worked up, and I put them in at $12. On the outlet system forebay I have loose rock excavation at $1.50; the reason for the difference being that this would be a comparatively small amount, and would all have to be handled by hand, and without using any powder. The outlet system tunnel is solid rock, and I have put it at $8.50 a foot. The excavation in solid rock at 4½ feet diameter
I have at $9, the difference being due to the fact that it was a 7185
smaller tunnel, and harder to handle. Neither one of them make any difference, the item is so small.

Francisco Street Reservoir: I have earth excavation at 40 cents; the loose rock at $1; the embankment at 25 cents; and clay puddle at $2.50. The brick and concrete work at the same prices of $10, $30 and $35. The material at Lombard Street is different from that in the Francisco Street Reservoir. At Lombard Street you have broken rock, and at Francisco Street you have broken rock, but not so much. I figured on using the steam shovel at both of those places. I don't think you would have to shoot the rock. I think you could handle it with a steam shovel without any additional cost, as it is not hard rock, the bank is not very high, and you would not be in any danger from falling rock. It is my judgment that there would not be any difference between the two with the steam shovel. It is my opinion that in the Lombard Street Reservoir it is more expensive to put in a brick lining on the slope than on the bottom.

On the outlet system at the Francisco Street Reservoir I have the tunnel at $8 a foot, and brick work at $40.

Clarendon Heights Tank: My prices on the three tanks in San Francisco were based on the cost of some oil tanks that we put in at Central Pump in 1911, and also on the record of the cost of the Presidio Tank, which was built in 1903, 1904 and 1905. I used 6 cents a pound. The Central Pump tanks were small tanks, and my recollection is they cost 8 cents a pound in place. I have
used 6 cents per pound in the steel work here. In the tank covers 7186
I valued the individual items, and arrived at a figure of $525.

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* See page 7195 for correction.

Clay Street Tank: I made a difference of one cent in the price there, on account of the plates being wrought iron instead of steel. I used 7 cents for the wrought iron, and 6 cents for the structural steel work. The cast-iron pipe was put in at the prices I used in the city distribution system, eliminating the excavation and backfill wherever it is shown as a separate item. There are a number of fittings in this tank, and I have used 4½ cents a lb. for cast-iron fittings in place.

The 4½ cents includes everything; any work necessary to put the fittings in place. The retaining wall I have put in at $10, and the earth excavation at $1, because that was mostly trimming.

Presidio Heights Steel Tank: As to that I have used the same unit prices, with the exception of the excavation of loose rock, and
7187 for that I have used $1.25. The overhead percentages are the ones that I am using. I have figured on overhead and interest during construction, and those figures are mine.

On the Oceanside Tank I probably took cost figures as Mr. Hazen did.

Dillman

Witness: Geo. L. Dillman for Defendants.

DIRECT EXAMINATION BY MR. SEARLS.

I have done excavation work which is comparable with the city distributing reservoir work. That is ordinary excavation embankment, with the addition that the bank should be built up in comparatively thin layers, the materials rolled or spread or compacted in such a way that the initial shrinkage would be nearly the total shrinkage. It has no peculiarity.

Most of my reservoirs have been built above ground for the city
7188 waterworks. As I say, any excavation and embankment is comparable with those by making that difference in the manner of disposing of the material. The excavation is identical with any other excavation of similar material. Where the job is large enough it could be handled nicely with a steam shovel. A steam shovel will excavate much harder material without trouble than any other methods of excavation. The material is earth, loose rock, and solid rock, the only difference being the compaction in the banks. I made an excavation of a 14-foot well that was built at Oakdale in 1911, and bricked for the entire depth of 50 feet. This is a well for the city water supply, and in the bottom of this structure are located the pumps of the system. So far as the excavation and brick work go, it is not far different from the excavation and brick work of any excavated reservoir. There are no banks in connection with it.

Questioned by Mr. McCutchen.

The diameter is 14 feet, and it is 50 feet deep. I mentioned this the other day in connection with brick work, and said that I thought

the brick work in place cost about $25 a thousand. I am confirmed in that by this letter, which gives the total cost as $2,550. The excavation is 285 cu. yds. at 50 cents. The curbing, as near as I can figure it, is 40,000 brick, at $25 a thousand. The work was done by contract, and while I do not know what the profit was, I believe it was satisfactory to the contractors; these figures are what the city paid for the work. The excavation was 285 cu. yds. at 50 cents, $142.50. There were some iron rods run vertically through this
curbing, and the shoe for the curb, which I put in at $125. There 7189
may be some little error in my memory as to the cost of the curb, but if the brick cost more than $25 a thousand, the excavation cost less than 50 cents, and vice versa.

DIRECT EXAMINATION BY MR. SEARLS.

In addition to that, I have had a good deal of experience in embankment work in railroads and ditches.

University Mound Reservoir: The principal item is the excavation, 208,000 yards. This is a big enough job to move a steam shovel on to, or it could be done with plows and scrapers. The haul is not great, and I have estimated that at 25 cents. The compacted fill I have estimated at 15 cents, considering that some of the excavation was hauled into the fill, so that the 15 cents is simply an addition for the compaction of that material. In constructing such work, I used a method of compaction of either rolling or tamping in layers. The macadam bottom 10 inches thick I have estimated at 80 cents a sq. yard. The concrete slopes at $9 a cu. yard. The concrete bottom at $8 a cu. yd., and the asphalt paving, 4 inches thick, at 12 cents a sq. foot. The asphalt and felt waterproofing on the slopes at 8 cents a sq. foot. and the asphalt on the bottom, 2 coats, at 3 cents a sq. foot.

The piping I have grouped in various bunches here. It is a small item, $625. The fences are $736, and the cultivation I have put at $1,045. The making of a farm is probably about as variable
in cost as any work on earth; there is half an acre of lawn, and 7190
hedge, and bushes and shrubs. I am not especially pleased with the estimate, but it is what I have. The items bushes and shrubs can be anything; I figured them at 25 cents apiece.

Excavation of earth for the inlet system I have estimated at 40 cents; concrete $9; redwood $40. The brass screens at 20 cents a square foot; 70 lbs. of dogs at 5 cents a pound. The pipe I have estimated at practically the same prices as the outside piping. My unit prices on piping were 144-inch $8.65; 36-inch $6.05. The excavation 60 cents a cu. yd.; backfilling 20 cents; concrete $8; redwood $40 a thousand. The excavation of the main reservoir could be done by steam shovel, or it could be done at these prices with scrapers. My units for wrought iron pipe are the same as those I

gave during the discussion of that subject. There is a cast-iron
T at $9. I figured the 6-inch cast-iron pipe at $1.05; 6-inch offset
7191 $10; 6-inch cast-iron T $7; cast-iron solid sleeve $4; 6-inch cast-iron
plugs 5 cents a lb.; earth excavation and backfill 70 cents, 50 cents
for the excavation, and 20 cents for the backfill. The water and
sewer connection figures up $162. There are various small items,
the biggest item being 3-inch cast-iron water pipe, 28 feet at 36 cents
a foot. There is some more farming here, and I made those shrubs
and trees cost $1 apiece.

7192 It would cost a little bit more to spread the concrete on the surface than it would on the bottom by reason of the bottom being level; at the same time the slopes are fairly easy, and depending on the way the concrete was mixed, none, or few forms would be used on the slope. Of course, there would be no need of forms on the bottom at all. That is to explain how I arrived at my price of $9 per yard for concrete slopes, and $8 for concrete bottom.

7193 College Hill Reservoir: I have estimated as excavation 25 cents; embankment made from the excavation 15 cents; clay puddle $1 a yard; rip rap 6 cents a sq. foot; rubble masonry $10 a cu. yd. That makes up the principal cost of the College Hill Reservoir in my estimate. Lumber I figured at $40 a thousand in place. I think small amounts of cast-iron pipe I have estimated at about 5 cents a pound; larger amounts at a lower price. The principal item on page 265—which I think is 225 in the Spring Valley Schedule—is the item of gates; 30-inch cast-iron gate $500; 30-inch bell gate $400; a cast-iron T at $100; 30-inch wrought iron pipe at $5 a foot.

In the inlet system I have earth 50 cents; backfill 20 cents. In the outlet system I have loose rock excavation $1; earth 50 cents; backfill 20 cents.

NINETY-NINTH HEARING. FEBRUARY 17, 1916.

Witnesses: G. A. Elliott for Plaintiff.
7194 Geo. L. Dillman for Defendants.
J. H. Dockweiler for Defendants.

Mr. Elliott: My appraisement is as of December 31, 1913, and I have borne that fact in mind in putting my appraisement on these items.

On pages 241 and 242 I had a value of $3,000; that was incor-
7195 rect. The present price is $1,411, and that is the actual cost.

Mr. Hazen: My figures should really be the same as Mr. Ellott's, if that is reduced; I am $300 too low. I got the right figure, but it covered too many items. It is not quite $300.

7196 Mr. Bailhache and I went through the records of the Western Pacific and saw the original vouchers, and there were two items which I think should be classed as overhead in this total. The first is an item

of $344.15, for which no voucher was shown, and which was a part of some account which was distributed pro-rata to this work, and of which the details are not apparent; I think that should be assumed to be overhead; also a charge of $876.14 made by the Spring Valley Water Co. for engineering and superintendence on the lining of the tunnels. These two items amount to $1,220.29, and I think to get the cost without overhead this could be deducted from the figure formerly given, leaving $28,414.25 without overhead. That compared with my estimate of $26,536, and I think that this record covers the same work that is covered by my estimate, so that the actual cost exceeds my estimate by $1,878, or about 7%. The Western Pacific Railroad furnished the timber, the cement, broken stone, and some other 7197
materials.

Questioned by Master.

Those are included in the vouchers; the vouchers did not show the superintendence on the part of the Western Pacific. I assumed that it was supervised, and that the cost of supervision is in their general engineering account, except for this item of $344.15, which may have been engineering, or something else. There is certainly no charge for supervision in this voucher.

The man who had the sub-contract was named Bican, and he says that he got $12.75 for labor only, Stone furnishing the drills and some other equipment. The Stone contract for driving was $15 a foot and the lumber, and the sub-contractor got the lumber also, so that was a stand-off as far as Stone was concerned. I understood that the sub- 7198
contractor got $15 for placing the timber. I suppose that charge went forward to the Western Pacific.

Witness: Geo. L. Dillman for Defendants. Dillman

DIRECT EXAMINATION BY MR. SEARLS.

I have been connected with a great deal of excavation for many years, and with the ordinary price for excavation in large quantities, including considerable haul, and the proportionate cost has not run over 20 cents a cubic yard for very many years on railroad contracts and on canal construction. It is comparable with that kind of excavation. The quantities are large enough to establish a camp, where the cost of moving on and off the job is not excessive, and would not exceed the ordinary contract prices. I would state, as a definite case of excavation, that the Valley Road contract was let, paying one way, and including several feet of haul, I think it was 500, at 8 cents a cubic yard. There was some other haul paid when the haul exceeded that.

Questioned by Master.

That was in 1894 or 1895, I think. The Western Pacific excava- 7199
tion was let under 20 cents, under rigorous specifications as to finish,

and considerable haul, and that contract was let in 1905, and the work progressed through 1910.

Questioned by Mr. McCutchen.

I am referring now to their earth work contract. The price was not entirely uniform. It ran under 20 cents for earth. The contract for the excavation of the earth work of the south side laterals in the Oakdale District in 1911 was let for 20 cents a yard. The contract for the north side laterals, which were largely in earth, was let for 15 cents a cubic yard. That was let in the same year, 1911.

I have here a compilation of some recent bids for excavation in that same country this year. The work is being done now under the supervision of Burton Smith. I got the information from the records of the Irrigation District at Oakdale. These bids were accepted, and the work is progressing now. These are the bids that resulted in the
7200 contract for this work.

I have some puddle here which has been let at 50 cents a cubic yard and some timber and tunnel excavation contracts which were let, and the work is progressing now. This is for excavation. The bids are quite comparable. The extreme high bid was 40 cents. That bid is exactly double the highest bid of any other bidder. The next bid is 24 cents, bid on two items, and they range from that down to $8\frac{1}{2}$ cents. The bids for excavation for which these contracts were let are 13 cents, $13\frac{1}{2}$ cents, $13\frac{1}{2}$, 15, 15, 15, 15, and $8\frac{1}{2}$ cents.

Questioned by Mr. Searls.

I think those different figures depend upon the character of the
7201 material. This material is largely earth. It was let without classification. In some cases they ran into hard material; they did on the contracts that were let for 15 cents, and 18 cents, that I mentioned a minute ago. I allowed for some little extra on account of that hard material, but the country is opened up now, and they know what this hard material is, and where to find it, and these contracts are let as formerly, without classification.

Questioned by Mr. McCutchen.

I have not read these contracts. I am talking about the contracts, and about the contract cost, and I know those contractors, some of whom live in that neighborhood, and I know some of the others who do not live in that country, who have bid on this work, and the facts are as I have stated.

Questioned by Master.

The different figures which I read were contract figures for excavation. The fact that there are a number of contracts is explained in that there were contracts for different pieces of work. These are extensions of laterals. The first one that I read is the Cometa Lateral; then there is the Leitch Lateral; the Young Lateral; the Swede Lateral; and Adam Lateral. Then there is the West Pump Lateral. It

was let to different contractors. The Cometa Lateral at 13 cents was 7202
let to James Willison, as were the Leitch Lateral, and the Young Lateral. The Swede Lateral, and the Adam Lateral were let to L. U. Hoskins, as were also the two that I do not recall the location of. The West Pump Lateral was let to J. D. Niman.

Questioned by Mr. McCutchen.

There was nothing furnished to these contractors. I know that the contract does not provide for furnishing anything to them. I know that they were to deposit the material with a short haul, through my knowledge of the country. I say it is a short haul; it is simply excavating and dumping alongside. It is a haul that was 15 or 20 feet, or something of that kind. The operation of excavation does not place it directly in position. It has to be pulled to one side and put 7203
in the bank. It is loaded in scrapers.

Questioned by Master.

The excavation makes the bank of the canal. There is a little additional work to be done besides the excavation. It reads, "Ground "under all embankments shall be thoroughly plowed and loosened up "before the embankment was made". "Earth to be excavated will be "measured in excavations. It will be classed as open excavation and "tunnel excavation." "Embankment will not be estimated when "excavation is in excess. When embankment exceeds excavation in "any 100 feet station, the excess quantity shall be estimated as exca-"vation." That would be interpreted to mean that 100 feet would be the maximum haul required, but as a rule the haul is much shorter than that.

Questioned by Mr. McCutchen.

The size of these laterals, as a rule, is 6 to 20 feet wide.

Mr. Hazen: I have had that sort of excavation done myself for less than 15 cents, but I did not consider it comparable with any Spring Valley work.

Mr. Dillman: I have not put the 15 cents nor 8 cents in any of 7204
my prices.

Questioned by Master.

On this Lake Honda, mine is 30 cents for excavation. I do not think it is uniform for earth excavation; it depends more on the haul than any other one thing. There is a great difference in the cost of loosening different earth material, but there is nothing especially difficult about any of the excavation of these reservoirs that is classified, and where it takes a higher classification, it takes a higher price.

Questioned by Mr. Searls.

Lake Honda Reservoir: The principal item of excavation is the sand, which I have estimated at 30 cents. Sand is very easy to excavate, but it is hard on stock; on account of the footing and the haul here, it is a little greater than at University Mound on the average.

I do not find any indications at Lake Honda that there would be an excessive difficulty with water there. As a matter of fact, sand is a little bit better to work if it has some moisture in it; of course, if you have to work it under considerable water, that would add to its cost, but a moderate amount of water which will go out with the scrapers is really an advantage in many cases; while it would add to the weight, the stuff hangs together better.

7205 Mr. Hazen: It is my opinion that there was a lake there before the reservoir was constructed, and that you would have to deal with a small lake in constructing that reservoir, although I did not make any such assumption. I reflected the cost of dealing with that lake into the cost of excavation, which I estimated at 75 cents per cubic yard. I got my information as to that from inquiry, and there was something which Mr. Sharon got from the "Daily Alta", which was a newspaper dated April 3, 1865, and which tells something about the conditions of Honda, and the difficulties in the early construction. I also made inquiry from Mr. Schussler as to the early conditions there. I did not look at Mr. Schussler's testimony in the last case. As far
7206 as Mr. Schussler is concerned, I think it is hearsay, because this work was done before he was connected with the system. I do not suppose any man living could tell what the conditions then were.

If the reservoir had not been built before 1913, it could not be reproduced in that location, and in my judgment it was perfectly certain that that ground would have been used for other purposes, so that the construction of a reservior would have been possible. As to the existence of the lake, this matter influences my judgment somewhat: The Honda excavation is in shape exactly like at least a dozen other holes between Honda and the Pacific Ocean, and the majority of those holes are lakes at the present time. Honda is built in a canyon, but I did not see any indication that there was an opening. These other holes between Honda and the ocean did not have openings, and
7207 the water stays in them. These are not along the Sloat Boulevard, but they are distributed all the way from Honda to the ocean. I have no way of identifying them, but I walked from Honda to the ocean, and I saw these holes, and saw the water in them. I don't know the name of the district that they are in, but it may be the Parkside District.

Honda drains toward the north. The sand dunes are on the other side of the rocky ridge to the west of Honda, and that is where these holes are with the water in them. I did not notice any lakes on this
7208 side of the ridge.

7209 I do not want you to think that I attach too much importance to this newspaper report, because I do not think I did. I tried to make a reasonable effort to find out everything I could about the conditions, but this was one of the scraps of information that came my way; I also relied a good deal on the general topography, and also took into account the fact that it was driven in sand, and seeing what the drifting

in sand does elsewhere in similar conditions, not far away, I drew some inferences of my own from what I saw.

Mr. Elliott: I have no exact information as to whether there was really a lake there or not, but as to the probability of there being a lake, I have something that I think throws some light on it: The 7210
reservoir basin had a certain amount of excavation, which has been agreed to in order to form it, and that excavation does not completely fill that basin, which means that there was a hollow there, providing there was no outlet at the north end. So far as the probability of the outlet at the north end is concerned, I just finished sinking a shaft there right next to the roadway, in the gap, and that went through absolutely hard, solid rock that was in place; it was not a fill, which indicates, of course, that the water had to fill in this basin, and flow over the top to get out. As to the probability of the water being there, just one block north of Lake Honda there is another similar sink at a slightly lower elevation, and that, until it was filled in 1914, always contained water; there was always water running through it. In fact we had to put in that sewer that we were talking about yesterday in order to drain it. That also belongs to the company, and I can say offhand it would probably cover two or three acres. There was no lake there; it was swampy, and in the winter time there would be a few feet of water in it, and in summer time you could not walk on it, because you would sink down 6 or 8 feet in the mud. It was always a swamp in the summer time, and had a few feet of water in the winter time. 7211

DIRECT EXAMINATION BY MR. SEARLS.

Mr. Dillman: If I have a swampy condition, such as I have heard described, it would depend on how swampy it was, how much material was affected by moisture, and the cost of drainage, whether that would increase my excavating price. If there was a pond there which had to be drained off before you could get at the excavation, that cost of drainage could be added in my estimate, whatever it was. I saw nothing peculiar about that excavation, and there is nothing to be seen now. I never heard of it having been originally a lake, and if it had been, the agreed inventory should have included something for a drainage ditch to drain it. This is the first evidence that I have ever had that this was wet excavation.

The Master: I think the inventory, when it says sand, has gone 7212
about as far as we could reasonably expect. I think the engineers must determine for themselves whether the sand was presumably wet or dry, whether there can be any water there or not. You have got to look at the ground in order to appraise the property.

DIRECT EXAMINATION BY MR. SEARLS.

Mr. Dillman: The Laguna Honda I saw when it was empty, at the time of the earthquake. There were some cracks in it, and it

largely emptied itself, showing a pretty good drainage there at that time. That would be enough to convince me there was not much trouble in avoiding water in the original excavation.

Questioned by Master.

Mr. Dillman: I do not know whether there is any sewer that would account for that drainage in these structures that we have
7213 here.

Mr. Elliott: The outlet for the Lake Honda Reservoir goes through a peak of hard rock at the north end; those tunnels are included in the schedule.

Mr. Dillman: I am not very sure that the lake drains through the cracks that were found. It was a hasty examination, made in the exciting times after the fire. The reservoir was empty, and I noticed the construction of the bottom buttresses, but I did not take special pains to do that. If it had drained in that way, it would have been possible to have kept it filled, because it was at the time of the earthquake that the lining was cracked. I imagine that some of the water ran into the pipes to supply the city during the time the lines feeding them were cut off.

Mr. Elliott: It is possible to drain the lake through the lower outlet. There are two tunnels in the schedule; one starting at the bottom of the lake, and running down Seventh Avenue, and the other about 14 feet above. The one from the bottom was built at
7214 the same time that the lake was built, and it contains a 16-inch pipe which will drain the lake.

I think the way to build that reservoir would be to build the tunnel first and drain it; you would still have the water in the ground, and still have water in the bottom of the lake where you have to make the floor for the reservoir. The water would be passing through the bottom, and that would have to be taken care of. That reservoir has a flat floor, and that water would spread all over the floor, unless it was taken care of. The water would have to pass through the floor of the reservoir to get to the tunnel, and the tunnel would be used in taking care of it, and also the seepage from the hill. The lake at the north end is full of ground water. We had to pump when we sunk this shaft. It seems to be fairly tight, as far as getting out down below is concerned.

Questioned by Mr. McCutchen.

Mr. Dillman: I think the water which was in the lake at the time of the earthquake was used just as fast as they did use it, and I think it was lost in various ways, but undoubtedly it escaped through the cracks in such a large way that they did not fill it again until the repairs had been made. I know it was empty for a long while at that time, and I presume it was because the seepage was

doing damage. If it was a tight basin, there would have been no reason for emptying it so completely. They kept it empty for 7215
several weeks. Lake Honda was not the first reservoir used with the outside water from the Peninsula reservoirs.

The Precita Pumps were put in as a temporary supply, I think. I was one of the Committee of Fifty at the time of the earthquake, and I was the active man in developing these small additional supplies in town, getting old wells in commission, pumping them out, having them tested, etc., for use of the residents out there, to avoid a water famine. In that way I knew what was going on at the time in the regard to the resumption of business by the Spring Valley. It was in the troublesome times, and my examination was not made for the purpose of preparing for this estimate. I think that all of the water in Lake Honda at the time of the earthquake that could be beneficially used was used, but my understanding is that the reservoir was so ruptured that it was not safe to use it, and I assumed from that that the loss by these cracks was dangerous. I mean by that, it was not safe to refill it until it was fixed again.

I think it was filled from Lake Merced when it was filled. My 7216
figure of 30 cents for excavation would not permit of handling marshy ground. If that excavation was all in marsh, it would add to this the amount necessary to drain it by a pump or a ditch. It ought to be constructed with a lower tunnel outlet first, if there was water there, and the water drained that way, and the excavation made as the swamp dried out. I would start with my outlet tunnel running at the north end of the lake; after putting that in, so as to get it in connection with the water from the lake, I would let it drain, and then start in at the south end of the lake to excavate. The tunnel should go below the bottom of the lake in order to make effective drainage, or cheap excavation. A couple of feet 7217
is enough.

The item of solid rock I put in at $1 a yard. The puddle I have estimated at $1, and it seems that this clay puddle was put on top of the concrete to make it tight. This is the only place I have ever seen it used. It seems rather doubtful as good engineering, but I am not making that criticism here. I am estimating it as it is in the schedule.

Questioned by Master.

As I understand it, the clay puddle is on top of the concrete. The concrete was put on the sand, and then to make the concrete tight, so it would hold water, the puddle was put on top of the concrete.

Mr. Elliott: That puddle is on either side of the wall, dividing Lake Honda into two halves; that was a concrete wall built with

counterparts by Von Schmidt a great many years ago, and Mr. Schussler—this is hearsay—was afraid that the wall was not strong enough to stand the pressure of the water, so he increased this section by putting timbers on the outside, and filling in between with the clay. It was more in the nature of making a dam out of it than to make it tight.

Mr. Dillman: I did not understand it that way. I understood it was on the water side of the concrete lining. I did not understand that it only pertained to the cross wall.

Mr. Elliott: That is my understanding.

7218 Mr. Dockweiler: My recollection is that that clay puddle is laid on the floor of the reservoir, but I would want to see my notes.

Mr. Elliott: That clay puddle is exposed to view when the water is low. I do not say that there is none under the floor of the reservoir, but I do say that there is some on the concrete wall on either side.

Mr. Dillman: This puddle clay is something that you can spend a great deal of time and money on if you want to, but I doubt if you can spend any time or money to advantage beyond a cost of $1 a cu. yd., unless the cost for the haul of material is very great. I have assumed that the material would be obtained within 600 or 800 feet of where it was used, although I do not know that that was the case. I know that there are some spots of clay material scattered through the city. If this clay was hauled up from San Mateo County, it would cost a great deal more money.

Questioned by Mr. Searls.

Mr. Dillman: I assume that there are clay banks within half a mile of there, but I have not located any. I do not think that the
7219 puddle in my Oakdale experience was all clay. I know that country, and the bids for puddling there, and this including the excavation, placing and puddling, runs from 40 cents to 75 cents a yard. That puddle was designed for making a small dam. It was a small amount of puddle for that matter. There is material near Oakdale that would be perfectly satisfactory for this purpose.

Questioned by Mr. McCutchen.

That material is in connection with the Cape Horn Tunnel, which was let by the Oakdale District to James Willison. It was not pure clay. It is clayey material, but it is very properly a puddle material. There is sand mixed with it; I would not say rock, but often times there is small gravel, although I do not think that is the rule. This particular bank that I refer to is 7 or 8 miles east of Oakdale, on the north side of the Stanislaus River. I think that material
7220 would run from 50% clay down. I don't think it is more than 50% clay. It might go down to 20% or 25%. It would not have a large percentage of small pebbles in it, but it would have a few small pebbles.

Questioned by Mr. Searls.

The material that they used in the Oakdale structures appears very satisfactory, and puddles itself without manipulation; it is sufficiently clayey for that result.

Referring to the concrete lining, I have used $8 for the bottom, and $9 for the slopes per cu. yd., concrete in place, and for the concrete walls I have used $9. For the rubble masonry I have used $10, and for the brick masonry $20 a thousand; for the ashlar masonry I have used $12 per cubic yard. For the cement plaster I have used 3 cents per square foot, and for the asphalt waterproofing, which is simply a wash, I have used 1 cent per square foot. There are more small items; wrought iron pipe, earth excavation 50 cents, backfill 20 cents, 30-inch pipe $4.50.

The first item attached to sewers is structure 23, and for that 7221
I allowed $61; 6-inch cast-iron pipe $1.05 a foot; 6-inch valve $12; 150 lbs. of stems at 8 cents, that is the turned stems.

Questioned by Master.

For wrought iron pipe, earth excavation, I have allowed 50 cents, and backfill 20 cents. When I mentioned my figure on the riveted wrought iron pipe, in the early portion of this investigation, of 50 cents, I do not remember whether that included my backfill at that time. I rather think it did.

Mr. Ellis: 50 cents is the price of excavation and backfill, outside of San Francisco, as Mr. Dillman says.

Mr. Dillman: This is a small job, and would take a higher price than a large continuous job, such as the large pipe lines.

Questioned by Master.

The trench excavation at Oakdale was 26 cents. The backfill was a price per lineal foot of trench. I don't remember what that was, but I can get it. I cited it as indicative of the cost of trenching in the country. I said also at that time that my original estimate on that was 40 cents, and that the accepted bid was 26 cents.

DIRECT EXAMINATION BY MR. SEARLS. 7222

Mr. Dillman: Lake Honda: Sewer, strainer-house, item 34, page 155, earth excavation is only 3 yards, 50 cents, and concrete at $8.

Potrero Heights Reservoir: I could not see the excavation there, but there is nothing in the country there to indicate that an excavation of that size would get into a classification higher than loose rock.

Mr. Elliott: The Potrero Heights Reservoir is on top of the hill, near the gas works and Union Iron Works, in the Potrero.

Mr. Dillman: I do not want to be understood as testifying to the fact that there was no solid rock in that excavation, but I do want to state that there is no indication that I saw of that, and I

have accepted the inventory classification as correct. My figure on that was 50 cents a yard.

Questioned by Mr. McCutchen.

Mr. Dillman: Earth ordinarily shades into loose rock. The line of demarcation is not well defined, and loose rock gets a little harder, and finally shades into solid rock, and it is a matter of personal deduction of the man who does the classifying. For that reason, I have of late years eliminated the classification in such cases entirely, and let them work for a flat price per cu. yd., and I have found it very satisfactory. This work, unless it does get into very hard
7223 material, should be done for 50 cents a cubic yard.

DIRECT EXAMINATION BY MR. SEARLS.

The wall I have put in at $9 a cu. yd., and the concrete lining at the bottom at $8; the brick work at $20 a thousand; the plaster, bottom and sides, at 3 cents a square foot.

Lombard Street Reservoir: Earth excavation 25 cents; loose rock 50 cents; embankment of both earth and loose rock 20 cents; earth borrowed 30 cents. I did not locate any borrow pit for that. I assumed it would cost a little bit more than it would to excavate the regular excavation and waste it on the sides or put it into the bank. This 20 cents for embankment, both earth and loose rock, is simply for the handling and compacting of the material that was taken from the other excavation. The earth borrow is the excess of material that was used in the bank, so that all of the earth excavated was used in the embankment, plus some borrow. Brick lining I estimated at $25 a thousand, and rubble masonry I have taken at $10 a cubic yard.

Questioned by Master.

That is the masonry wall, which consists of rubble masonry and cement plaster. The rubble masonry is 683 cu. yds., at $10, $6,830; cement plaster, 3,020 sq. ft., at 3 cents, $91.

The Master: During the recess I suggested to Mr. Hazen that
7224 in my experience here on this peninsula there were ample quantities of what I considered was clay, and therefore it did not seem necessary to go to San Mateo County, and Mr. Hazen stated that in assuming a reproduction in 1913 such clay would not, in his opinion, be available, because of the population in the city.

Mr. Hazen: I have seen a great deal of material that had some clay stock in it, but I have not seen anywhere in the city anything that looked to me like puddle clay in a place where it would be available for excavation. I should expect it to occur in flats. I have been through Sutro Forest, but I did not notice anything along the bank below the Relief Home that I recognized as puddle clay. I don't know what they puddled the dam with through the Merced Ranch. That dam is very small. My impression is that that material

below the Relief Home is a fine sandy stock that looks like clay, but 7225
would not stand up in puddle.

Mr. Ellis: I have seen clay deposits on the Merced Ranch. They showed me the puddle from which the clay was taken for either one or two dams—it has been 2 or 3 years ago—it was about a mile up the road from South Pond. I went up there with the man who is the attendant down there, and I asked him if he had any clay on there, and he showed me the clay deposit from which they took the puddle for the South Pond Dam, and such other puddling as they did, which I do not think was extensive.

DIRECT EXAMINATION BY MR. SEARLS. 7226

Mr. Dillman: Francisco Street Reservoir: The units are 25 cents for earth excavation; 50 cents for loose rock excavation; 10 cents for embankment, that is haul part of the excavation, and that 10 cents is for manipulation; clay puddle $1; concrete $8; brick $20; cement plaster 3 cents a square foot. I don't remember now why I used $25 for brick on the Lombard Street Reservoir, and $20 on all the other structures. There is no particular reason for that discrepancy.

On the tank reservoirs I assumed a base price for plates of 5 cents, which is the biggest single item; excavation 25 cents; concrete $10; these prices seem high enough for a tank of that capacity. I built at Oakdale a reinforced concrete tank, of about the same or a little greater capacity than the Clay Street Tank, in 1911 or 1912, for about half the gross cost of this tank. I did not add anything for wrought iron from steel, but considered it at the same price. As a matter of fact, here is a case where I doubt if the wrought iron has any value in use beyond steel, and I do not know why it should have any greater cost.

Mr. Hazen: That was a wrought iron tank.

Mr. Dillman: I give that at $4,827, but I include in that my excavation and concrete foundation. The life of the tank depends
on its care and maintenance, and the outside of the tank can be 7227
painted as often as desired, and the inside once in awhile, so that you do not have to depend on the single initial coating for the life of the tank. This tank has a capacity of 225,000 gallons. I would also compare with that a reinforced concrete tank at Oakdale which cost less, with more than twice the capacity.

The Presidio Heights excavation is inventoried as loose rock, and I put that at 50 cents; the concrete at $8; steel at 5 cents; and all lumber at $40, which is in the tank cover.

The Oceanside and Meyers tanks are small tanks. The Oceanside Tank I computed in total, $1,154; the tank itself, with the tower, I computed at $800. The Meyers, which is a wooden tank, I computed at $987, the accessories being small in comparison.

Witness: J. H. DOCKWEILER recalled for Defendants.

DIRECT EXAMINATION BY MR. SEARLS.

University Mound Reservoir: My unit price for excavation on that was 26 cents, and I figured on using a steam shovel. I obtained that figure by my usual method of analysis of costs of labor, teams, and machinery and so on. I used scraper work on part of the excav-
7228 ation until I could get what I considered an economical condition for the shovel to work in. My price is 26 cents for that. I allowed 10 cents extra for compacting the 34,926 cu. yds. That material is hauled in by Fresno scraper work, then it is rolled and sprinkled, and given the consolidation through that method of handling it. I determined the macadam lining as at 92 cents a yard, and that price resolved into sq. yds. gives you the 35 cents. This is macadam bottom, 2 layers, 5 inches thick after compacting. I assumed it was rolled with a steam roller after it has been spread. I hauled that from a distance of 2500 feet from a quarry. I ascertained that material could be obtained from the owner of the premises at 8 cents
7229 a yard, and that is what I mean by paying a royalty on it. The cost of the rock was 11 cents; breaking and loading it 20 cents, and hauling it 23 cents; spreading it was 4 cents, and rolling it 11 cents.

Taking concrete; I have used a price of \$7.50 for slopes, and \$7 for bottom. The cost of my material per yard at University Mound is \$5.63 per cu. yd. of concrete. Then I assumed the cost of labor and placing, mixing and placing it, as \$1.08; water 15 cents; equipment 10 cents; runways 10 cents, to which I added 27 cents, giving me a total of \$7.33, and I used \$7.50.

A memorandum of Mr. Dockweiler's, giving such items as could be readily segregated, was offered and received in evidence as "Defendants' Exhibit 145".

Mr. Dockweiler: The difference between the \$7.50 and \$7 for concrete on slopes and bottom was the difference in labor. The material is the same price. I used a unit of mixing and placing, 67 cents per cubic yard. That is based on the cost account of the labor of the Twin Peaks Reservoir. The workmanship on the Twin Peaks was a much better piece of workmanship than the University Mound. You can see some of the loose material at the University Mound, and it did not have that finish.

7230 There was a cost record of the Twin Peaks work gotten out by the City Engineer's Office in San Francisco, and that record was used in the preparation of this work. My labor costs in this were builded upon that. If it is 10 cents more a yard, my estimate must be increased that much for the labor. The City Engineer's records give a mixing and placing cost of 67 cents, and that record I have.
7231 This cost record that I relied on was prepared, according to the information given me, by the inspector for the City who was on the

job. I don't know whether this covers the contractor's overhead or not. My estimate is directly comparable with that work, because 7232
all other charges are separately taken care of by me in my figure. It is my understanding that all it is intended to include is the direct labor cost, and that it does not include any of the equipment charges. The 67 cents is the labor of mixing and placing, and I have no equipment in that at all. I used $13 each for screens, and they are brass screens.

Mr. Hazen: I used $20.

(Counsel for Defendants advised that he would be able to get, 7233
from the City Engineer's Office, in a few days, the contract price and the cost on these high pressure reservoirs that Mr. Hazen wanted, and that that also would cover the information that Mr. Dockweiler used this morning, as to the cost sheets.)

Mr. Dockweiler: The document that I have is a photostat of the cost sheets furnished me by the City Engineer's Office.

Questioned by Mr. McCutchen.

I identified these sheets on the margin. Where I have used labor to place, yards, that means cubic yards. The figure 66.4 cents is on concrete bottom slab. This is work comparable to the kind that 7234
was put in on the University Mound Reservoir. In other words, it is the bottom of the reservoir, and this is work put on the bottom of the Twin Peaks Reservoir. That is 750 cu. yds., and that is all there is of that bottom rock. The balance is other kind of work. I may have employed these figures in the other concrete work. I cannot tell, until I see my notes, just what I used, but I had a copy of this at the time I was making this appraisal.

The item, per yard to place $1.07, including forms, strips, and runways, $9.58, is the cost of the material, and you will note that in the first instance, where I gave you labor 66 cents a yard, that the materials used in that yard of concrete cost $7.20. The exact quantity here of cement, rock, sand, and other materials is given.

Questioned by Mr. Searls.

That had to be hauled practically to the top of the Twin Peaks, right to the base of the final slope.

Questioned by Mr. McCutchen.

This column that I have borrowed that from is headed "Concrete "bottom slab." On the second page beyond, where I have "west "for corner", I guess it is wall, and it would be west for concrete. The cost per yard to place is 97 cents. The cost, including forms, of $12.89 a yard, is a very high cost of forms. I don't know exactly 7235
where that is, but this is an analysis of the various items. I used that price, because it is my opinion that it is a similar kind of work to this. I don't know the name of the man who made this up. It was given me by the City Engineer's Office, and is a copy of their

records. It is a photostat copy of the allocation or segregation of the various costs as the contractor met with them.

Questioned by Mr. Searls.

Screens: I estimated the material at \$9.34; the labor at \$2.50, to which I added 62 cents, making \$12.46. Then I sent down a sketch to the San Francisco Mill Furnishing Co., and Mr. C. F. Hutchinson, the secretary, gave me a figure of \$12.75 per screen as the price that he is willing to do this work for. I rounded it off and took it at \$13. For cast-iron pipe, San Francisco, 4 inches, I took \$34 a ton; 6 inches, \$32.75; 8 inches, \$32; 10 and 12-inch, \$32 a ton.

Questioned by Mr. Greene.

7236 In the matter of the screens, I showed the man a sketch of the screen, and explained to him what it consisted of. We made the sketch in the field, and the material of which was to be made of brass. I used brass wire cloth, 45 sq. feet of it, at 17 cents a sq. foot; that cost \$7.65 alone.

Questioned by Mr. Hazen.

We got a quotation from somebody for that 17 cents, but from whom I do not remember. I think the wire is a ⅛ mesh. It is a brass wire cloth. I have not the gage here. The cost depends entirely upon the size of the wire.

Questioned by Mr. McCutchen.

I did not give him any exact weight of wire to figure on, as I remember. I know that he was gone a whole day, and came back with that price. ⅛ mesh brass wire cloth I have down here at 17 cents a sq. foot as the price that I used. If that is not the material, of course, to that extent the estimate is in error.

7237 Mr. Hazen: I should say, from memory, that my price was 30 cents. I have measured these wires, but I cannot find the record of the measurements. This is one of the older screens. I measured the wire on several of them, and I have often bought this wire mesh. I had some quotations on that, but I did not get any special quotations to use, more than I already had.

Questioned by Mr. McCutchen.

Mr. Dockweiler: It was just a verbal quotation that I got from them. It was on May 22, 1914.

Mr. Hazen: The wire has to be pretty heavy, because this wire is covered with cheese cloth, and if there comes a difference of head, and the cheese cloth presses on the wire, if the wire is not pretty strong, it would not hold it; if you have an ordinary brass wire cloth, of the weight that ordinarily would be quoted, if it was not specified, it would not be strong enough to hold it.

Mr. Dockweiler: It is a fairly strong frame; it is 3 feet high. It would be the wire that would make the difference. All I have here is ⅛ mesh.

DIRECT EXAMINATION BY MR. SEARLS.

Mr. Dockweiler: I have the cost of the Central Reservoir, built 7238
by the Peoples Water Co., in Oakland, during the year 1909-10; that cost covers every dollar expended by that company, and charged by the company to the construction of that reservoir. I was entitled to get that data by virtue of my position, which was that of consulting engineer to the City Council of Oakland on matters of water supply, and my contract required that I should submit to that body at the end of each two months a report of all moneys expended; a report which set forth all construction that the company had engaged in, and the cost of all these constructions, and also setting forth all charges that they made, all moneys that they expended, and whether these moneys were properly charged. I got that data from the vouchers and books of the company. This table was compiled from the total of the data which I have in my possession, taken directly from the books of the company, and the data from which I compiled this table was copied from the company's records, by Mr. Bailhache, at my direction.

The cost of the job was worked up by an engineer of the water 7239
company, and he prepared a report in which he segregated the costs of all the different classes of work. This data was compiled by the company, and I made a copy of it. This is an exact copy of data in the office of the Peoples Water Co., in Oakland, as compiled by C. H. Park, one of their engineers, and copied by Mr. Bailhache for me, under my direction. This is an exact copy of a paper which will be found in the archives of the Peoples Water Company. It contains the cost of the complete structure.

Mr. Searls: Mr. Dockweiler had the first 5 columns of this table 7240
all compiled, and there was an account of miscellaneous and general costs there which were segregated, in the details, and I asked Mr. Ellis to go through that general and miscellaneous table, and allocate to the particular items all the charges which might be called indirect charges under Mr. Lippincott's testimony.

Mr. Ellis: This table here contains all the figures that were shown 7241
on the original table; the figures up to, and including 5 are simply my copy of the compilation; they are all Mr. Dockweiler's figures. The figures marked column 6 miscellaneous, and column 8 indirect, are described in that record in the form shown on page 2 here, they are headed "miscellaneous and general". Page 2 shows just what I did. No. 2 describes all these items; there are a great bunch of them, and for the purpose of convenience, we grouped them together, but the detail is on page 2. I simply took these miscellaneous and indirect items and put them together.

DIRECT EXAMINATION BY MR. SEARLS.

Mr. Dockweiler: I have a copy of the contract under which this reservoir was built. The contractor received 15% in addition to

his payroll; then he was paid 15% in addition to all purchases made by him for materials. The contractor furnished the materials. He furnished everything. For instance, he would buy cement, and then he would bill that to the company, and add 15% to it. His equipment charge was provided for at a certain stipulated rental per day, to which he also added 15%.

7242 The third column marked "Fuel" is exactly as it is shown in the original. "Repairs" is the amount of repairs charged to the various accounts as indicated. "Material"; that is charged as indicated on the original. The contractor got a profit on material under the contract, and that is charged in. That charge includes his 15%, because I have a copy of every bill the company paid, and that was submitted; the totals of these bills check the total of the expenditures on the reservoir. These total indirect and miscellaneous charges are as shown on the second and third sheets of this compilation.

Questioned by Master.

Referring to a correction, or modification, as to the cost per cu. yd. on the first sheet, where I have it 43 cents, and on the original it is 45 cents: I deduct supervision and engineering, which is set out separately. I wanted to get the direct cost, so in the item of "supervision and engineering" that is added thereto; it will check out with the original.

Questioned by Mr. Searls.

The "supervision and engineering" is what the company charged up against the work for their own supervision and engineering. That is not what I classified under the heading of "general overhead". I have that as a separate allowance, and it is a percentage of my general overhead allowance. The total amount of that 7243 is on the first sheet. The equipment is charged here directly in labor.

Mr. Ellis: It is not on a basis comparable with Mr. Lippincott's, so far as the equipment goes.

Mr. Dockweiler: It can readily be ascertained how much the equipment charge is, because what they paid is set forth each day, and the nature of the apparatus that they paid rental on; for instance a car is charged at the rate of $1, 2 cars at $2; a mixer at the rate of $10 a day.

Column 11 of this table, containing the cost per cu. yd., is obtained by dividing the total number in column 11 into the total cost as shown in column 9, and the 48 cents written in at right angles there is the average cost per cu. yd. for all excavation. Column 12 shows the number of feet, cost of haul.

Questioned by Mr. McCutchen.

That is also from the records at the company's office. This earth work—steam shovel—means that that material is compacted in em-
7244 bankment work; that does not mean simply digging out the material,

and hauling it 1500 feet for 43 cents, but that means compacting in the embankment.

Questioned by Mr. Searls.

That includes every charge, excepting engineering and supervision. The item "Finish" is the trimming of the basin of the reservoir, smoothing it up; I am not positive just what that represents. It is my impression that it means the trimming of the interior slope of the dam so as to get it ready to apply the concrete lining to it. It also includes the trimming of the reservoir, the bottom and the sides. If it does not, I don't know what it represents. That includes the dam, and the sides, and bottom of the reservoir. In order that these figures may be comparable to the Spring Valley figures, $10,000 should be added somewhere, either to the concrete or to the excavation figures.

Mr. Ellis: "Clearing and appurtenant structures": They are 7245
all shown on the second page. Everything that I grouped on the first page I show in exact detail on the second page, so that it can be readily compared to the summation sheet of the company; in other words there are 2 items on the bottom of the summation sheet of the company, one entitled "miscellaneous $16,764" and the second "general $12,596". Now the distribution of those two totals is shown on the second page here, and all the details. The items which are marked "clearing and appurtenant structures" are such items as bridges, pipe lines, permanent appurtenant structures not properly a part of the embankment of concrete.

DIRECT EXAMINATION BY MR. SEARLS.

Mr. Dockweiler: This Central Reservoir was excavated in a clay formation. It was ideal steam shovel work. Lots of that work was done by means that were too expensive. The idea of trying to carry stuff with a wheeler 1400 feet haul, would show that there was very poor judgment used in getting that outfit. This is for a
1500 foot haul. My haul on the University Mound Reservoir, 630 7246
feet, is the mean haul; roughly, just taking a cent a hundred feet for haul, that would make a difference of 9 cents between my figure on the University Mound Reservoir and the figure shown here. Deduct 9 cents from 43 cents, and you have 34 cents. I allowed 10 cents for compacting in my estimate for University Mound. The 36 cents for the excavation and compacting is directly comparable to this here of 43 cents for 1500 foot haul.

The contractor got 15% on his equipment rental on the Central Reservoir. For instance, a mixer was set forth in the contract as being charged for at $10 a day; he not only got that $10, but 15% in addition thereto. If he rented the equipment from somebody else,
he was allowed a profit of 15% on his outlay for rental, and if it 7247
was his own equipment, he was allowed the rental plus 15%. He

also got 15% on his payroll. The company built the boarding house for him, and everything that you could conceivably imagine of; that is segregated, and it will show under the heading "building camp, "$2,683.81" what a cheap boarding house can be put up for.

The rentals, reading from the contract, which he was paid in addition to the 15% on this equipment, were as follows: Steam shovel $50 a day; steam roller $12.50; Erie Grader $15 a day; 10-horse plow team with plow and equipment, including driver, $21.50 a day; 8-horse plow team including plow and equipment and driver, $16.50 a day; 6-horse plow team with plow and equipment including driver, $12.50 a day; 4-horse plow team with plow and equipment including driver, $9 a day; 4-horse team with wagon, scraper or equipment, including driver, $9 a day; 3 horses with wagons, scraper or equipment, including driver, $7.50 a day; 2 horses with wagon, scraper or equipment, including driver, $6 per day; 1 horse with cart or wagon, equipment, including driver, $4 a day; extra horses, including harness, $1.50 a day; concrete mixer $10 a day.

These prices, without the addition of anything, would have a big profit in them. This is a copy of the original contract as it was
7248 handed to me by the secretary of the company. I want to state that a company that had credit could have done the work cheaper, because there was no reason that I can see why anybody should have paid 15% for making purchases. I felt that a considerable deduction from these prices was justified in comparing the job with my own. The Peoples Water Co. had the option of paying for the work, either in cash, or notes running one year, and they had to back those notes with bonds, which were taken at the market price, to which they would have to add 5% above the market price. It was a credit proposition. The contractor might have to wait a year for his money, or else discount his notes. It was 6% interest, too.

An exhibit entitled J. H. Dockweiler, Central Reservoir, Oakland, earth work and concrete, was introduced and marked "De-"fendants' Exhibit 146".

Questioned by Mr. McCutchen.

Mr. Dockweiler: George Wilhelm was the chief engineer of the company at the time this reservoir was being built. Mr. C. H. Park was the engineer that compiled these costs.

Questioned by Mr. Searls.

On the College Hill Reservoir the schedule gives the quantity
7248½ of excavation as 39,700 cu. yards. I have divided that work and classified it as follows: 4,200 yds. stripping; 34,300 reservoir excavation; puddle trench 240 yards; and 960 yards in another. I have determined the prices for the stripping as follows: Unit prices for
7249 the stripping 16.8 cents a yard, and the excavation 25.8 cents; on the puddle trench 62½ cents for one item, and 56.3 for another. Dividing the extensions thus produced by the total yardage, and

adding 25%, gives me an average of 32 cents per sq. yd., which I have used. The difference arises merely through the process of analysis.

The Central Reservoir was built in 1909-10.

College Hill Reservoir: I figured that there is plenty of clay within half a mile. At the time I appraised the property, I went on the ground and saw everything, and I made an examination to determine whether clay could be obtained within that distance. Rock costs $1.40 a yard, and the cost of a third of a yard of mortar $2.59, and the labor is $2.18. Total, $7.17, which I have called $7.25.

Lake Honda: I judged there would be difficulty to be encount- 7250
ered in excavating by reason of water. To handle the water I expected first to drive these tunnels, and use them as an outlet to carry the water away and drain the land. That is the first part of the work to do; it is a steam shovel job excavating that basin.

The total yardage of 104,600 yards I classified as follows: Rolled by steam shovel 90,100 yards at 27 cents; removed from the slopes 9100 yards at 48 cents. I have another charge of 9100 yards from sides at 16 cents, and then I have 7200 yards bottom dressing at 43 cents, and dividing the total price by the total yardage gives me an average price of 32 cents a yard. In excavating work of that class, the cost would vary with the class of material, as well as the length of haul. If an engineer should assume that there would be difficulty with water, and based his entire unit costs on the theory that all of the material might be excavated from water-logged ground, he would be apt to get a cost much higher than would actually be experienced. If
I have a proper idea of where that material was removed from, just 7251
digging at the bottom, and considerably from the sides—if you had a plank runway in there, your shovel would load that material and put it into the wagon; it is not like getting down to a trench and taking a spade to it. Your shovel would handle that wet material without any difficulty if you had a plank runway and loaded it into the wagon, and got it out. I have assumed a haul of 600 feet for the material that was taken out of there as an average. I have assumed that it was dumped three ways, up both ravines of the arm, up stream from the reservoir, part dumped in each ravine, and then part down below. I don't know the cost of dredging work, and I could not say whether it would be feasible to put in a dredger boat and excavate in that way had there been a considerable lake there.

The figure of $5 on concrete was arrived at as follows: The material per cubic yard, which includes the cement and rock per cubic 7252
yard, $3.51. The sand would be procured right at the place; I inspected some of the materials, and as near as I could get at it, it looked to me as if the sand came from that spot.

Questioned by Mr. McCutchen.

I made an investigation, I think, of some of that old plaster there,

or something, and it looked like the sand came from there. That is the basis that I made my estimate on. If the sand did not come from there. I am in error to that extent, but I did assume that the sand would be used that is there, because they built in the early days with dune sand.

Questioned by Mr. Searls.

There are large quantities of dune sand within a very short haul from there. On the side of the reservoir toward the west there are immense quantities of sand. The schedule itself designates the reservoir as sand. There are only 400 cubic yards of rock work in the whole excavation. You would get the sand there in 1913. I am using
7253 the rock there at the place. There are remains of what I thought was an old quarry around there. If it were not this rock, it was similar to that which went in.

Questioned by Mr. McCutchen.

The rock in the quarry is the same kind of rock that is in that concrete. The rock in the concrete came out of that quarry within 100 feet of this reservoir. I am going to produce that identical structure, and if the sand came from there, I am using it, and if rock came from there, I am using it.

Questioned by Mr. Searls.

Mr. Elliott: There is no sand bank in the Sunset District a short distance from Twentieth Avenue, that I know of, where they take out sand for that kind of work. The sand throughout the Sunset District, until you get down clear to the ocean, is rather dirty. We have just raised the reservoir at Lake Honda 6 feet, and we got all of our sand and gravel from the E. B. & A. L. Stone Co., of the Ocean Shore Line. I put in some concrete at the screen house, and I never used that rock that Mr. Dockweiler speaks of, or the sand in the immediate neighborhood, because the rock was too soft, and the sand was too dirty. The
7254 sand that we got for building the pumping station at Lake Merced came from the Grant Gravel Co., at Pleasanton.

Mr. Dockweiler: I am pretty certain that the sand and rock came from the vicinity, as a result of my examination of the rock. You can take that old concrete, and it is identical with the rock that comes from that quarry. I satisfied myself on that point.

Questioned by Mr. McCutchen.

I went around and saw some of that old work. I took a piece of rock and went up there and examined it, and it is identical. No doubt it is true that the late work has been done with sand and rock, probably hauled in, but in the early days they used sand from there. The
7255 nature of the mortar indicated, as near as I could judge, that that was smooth sand in that vicinity there.

Mr. Hazen: I don't think I could tell, from an examination of that stuff. It is sometimes possible to take concrete and dissolve cement out by dilute acid applied for a long time, and then get the ma-

terials for examination. I have not attempted anything of that sort in this case. It is not very conclusive at best, but it is sometimes done.

I did not make any inquiry as to where that material was originally obtained from. It was my judgment that the local materials were not suitable, and I figured on getting materials that were suitable. The rubble masonry stone, I think, probably came from this place that Mr. Dockweiler has spoken of. I don't think that it would follow that if the rubble was suitable, that the smaller embankments which would be used in concrete would be suitable. I have not heard of any sand ever being obtained near Millbrae, except as brought in on the 7256
cars. It is possible to use the sand, if it is very fine, but it takes a great deal more cement to go with it. It is very seldom economical to use a very fine-grained sand with the extra quantity of cement.

Questioned by Mr. Searls.

Mr. Dockweiler: Cement is $1.72 per barrel, sacked in warehouse in San Francisco; sand $1 per cubic yard at bins in San Fran- 7257
cisco; rock $1.25 a cubic yard at bins in San Francisco. That is the base price, and is what I have used in my concrete at San Francisco. I used as a base price of brick at San Francisco $7.

Questioned by Mr. McCutchen.

The cost of hauling cement one mile per barrel is 15 cents; sand per cubic yard 29 cents; and brick per thousand $1.44. The haul to Lake Honda from the point of receipt for brick is 5 miles. That would be 5 miles, $3.43 per thousand, which includes your price of loading it; after it is once loaded, it is immaterial how many miles you travel, as the loading is a constant price. I did not estimate hauling any sand or rock from the outside into Lake Honda. I assumed the sand and rock that was there was the material that was used, and I hauled in only the cement. I do not use these base prices of sand and rock at Lake Honda, because it cannot be; I have given the total aggregate of my materials, which shows that I have used the local material there. The total materials would come to $5.63 on the ground per cubic yard, 7258
if I had to haul the rock and sand out there, as against $3.51 that I have taken.

Questioned by Mr. Searls.

$2.12 should be added to my price per yard if the materials were obtained five miles away.

Questioned by Mr. McCutchen.

The difference of $2.12 is the cost of the sand and rock, and the hauling. The sand is $1 per cubic yard at the bins at San Francisco; the rock is $1.25 at the bins, and I have assumed 1.24 barrels of cement. .34 of a cubic yard of sand, 1.2 of a cubic yard of rock, as the materials required to make a cubic yard of concrete.

Mr. Searls: Mr. Dockweiler has included the cost of hauling the sand and rock out here for some distance, and he has added simply the difference between the city distribution concrete cost, where he

has purchased it and hauled it the entire distance, to his cost here, where he has not had to do it, so that the material and the haul would not check exactly; the table which you have here shows that if you figure his cost of sand in the Lake Honda Reservoir at 17 cents a yard, and the rock at 82 cents a yard, it makes practically $1.

7259 Mr. Dockweiler: The 17 cents is the cost of the sand that is included in a yard of concrete, not per cubic yard; it is the sand required to make a cubic yard of concrete.

Potrero Heights Reservoir: That loose rock that I have there should be soft rock; I think that would be more in keeping. I did not do the classification on that work, and I would never classify that stuff as loose rock. I went out there and saw it myself, and it is called soft rock; that is the difference; rock can be hard and loose, and it can be soft and kind of compact.

I classified 6,374 yards of that as 50 cent material, and 1,740 yards as $1.12, or $1.10 material; that gives me an average of 63 cents, and I used 65 cents. There is a part of that material that you would remove by means of a trap, and some of the top part you could loosen. You would have to shoot the rock; it costs you about $1.10 to get that rock out.

7260 The material there, taking as an average a 2-mile haul for that concrete, costs $4.64 a cubic yard, and the labor in mixing and placing that is $1.06. There are a very small number of yards. Then there is the cost of wire and nails, 5 cents; water, 15 cents; equipment, 14 cents; form lumber, 28 cents; the labor on the form lumber 75 cents a yard; and the runways at 25 cents. Then I added 45 cents to that, and it brings the cost of my concrete lining to $7.77, which I rounded off to $8. It is a wall around the edges of the reservoir, and it is about 4 feet high, 18 inches wide at the top, and 26 inches wide at the bottom. It is worth about $3 and some odd cents for all of the labor charges and incidentals.

Lombard Street Reservoir: I assumed that the earth was probably borrowed from the adjacent vacant property in the same block. I assumed that the property belonged to the company, and that is the way the estimate was made. If they do not own that property, my assumption is in error. I assumed that that material could be handled with Fresnos; the lead is up hill, and there would be about 150 feet haul.

Referring to the item "cement plaster"; I assumed the following
7261 materials for a 1 to 2 cement mortar, which, I take it, is the composition of that plaster; that is a very rich plaster; 3.2 barrels of cement, $6.40; .9 of a cubic yard of sand, $1.97; material delivered at job. That makes a total of $8.37; then there is 10% for waste, 84 cents, making $9.21. Now 1 cubic yard will lay 1,296 square feet a quarter inch thick. Dividing $9.21 by the 1,296 gives you .7 of a cent as the cost of material per foot. The cost of labor, water, runways, etc., get

it up to 2.7, which I rounded off to 3 cents. This price is based on University Mound Reservoir plaster, and is ¼ of an inch thick.

Mr. Hazen: My estimate is based on ½ inch thickness, and I have 5 cents.

Mr. Dockweiler: I have taken this as ¼ inch thick at University Mound. The schedule says ¼ inch at University Mound, 3 cents a square foot, page 259, Structure No. 10, Item No. 5.

Mr. Searls: It is page 219 of the Spring Valley inventory. It is shown as forebay outlet system, cement plaster ¼ inch, 800 square feet.

Mr. Hazen: I don't know as that should be taken as establishing the thickness of the plaster of the system or not. I would assume, generally speaking, that ¼ inch plaster would be pretty thin.

Mr. Dillman: In my experience, there is more plaster ¼ inch 7262
thick than the other; where ½ inch plaster is put on, it is usually put on with two coats.

Questioned by Mr. Searls.

Mr. Dockweiler: These figures I gave you were for the University Mound Reservoir, and based on plaster ¼ inch thick. Where it is ½ inch thick, that is, possibly, 4 cents a square foot, because the material costs you pretty nearly a cent a square foot for a quarter inch of thickness.

Questioned by Mr. McCutchen.

The labor will be practically the same in putting on the ½ inch as the ¼ inch, and the material costs .7 of a cent per square foot for your ¼ inch thickness. My price is 3 cents for ¼ inch thickness, and the labor is practically the same whether you put it on ¼ or ½ inch thick.

The loose rock on the Francisco Reservoir at 59 cents is material 7263
that is handled with a steam shovel. I loosen the material with powder. I handled all earth work on the Lombard Street Reservoir with plow and scraper. I had to shoot the rock there, too. The difference between the two is probably due to handling with steam shovel in one place, and plow and scraper in the other. The rock is just about the same at Lombard as at Francisco. The only difference is that it don't pay to get a shovel up on this job.

I used 6.6 cents for my steel in place, referring to the tanks.

Mr. Hazen: I use 6. We will accept his figure on that.

Mr. Dockweiler: On the Clay Street tank I assume wrought iron at 9.4 cents a pound.

ONE HUNDREDTH HEARING. FEBRUARY 18, 1916.

Witness: ALLEN HAZEN recalled for Plaintiff.

7264 CROSS EXAMINATION BY MR. SEARLS.

In figuring the cost of excavation and concrete in the city distributing reservoirs, I took such local figures as I had, and as were available, into consideration. I think I had some local data which I did not mention in my testimony, and which perhaps I should have done. I had, among other things, the cost of the tanks and reservoirs built for the City of San Francisco for the high service system, and
7265 I considered that as one of the things. I did not resolve it directly, but the general fact of what they had done, and the amounts they paid, was one of the things that influenced my judgment somewhat as to the reasonableness of the figures I reached. I had that data at the time I made my appraisal. It was obtained from the city records, through Mr. Behan, Secretary of the Spring Valley Water Co. It is not the same data that Mr. Dockweiler used yesterday, though it refers to the same reservoir. It is a different kind of data. Mr. Dockweiler has some records which some inspector made up, and which the inspector thinks represents the cost to the contractor on certain parts of the work. The data that I had represents the actual payments of the city on account of the structure; the two things are not comparable.

My data shows the gross payments. I was not able to make the separation with the data I had, but what I did do was to compare the cost of the finished work with the estimated cost of reproduction of the finished work of the Spring Valley system, taking into account the differences that there are, and that is a common way in my practice of estimating reservoirs. I am in the habit of thinking of the fair cost of the reservoir at so much per million gallons, taking into
7266 account the peculiarities of the site, and the local conditions of the construction, and while that is not a concise way of getting at it, as a broad general check it is exceedingly helpful. I would consider it as a check on my estimate after it was made, rather than as a proper basis for making the estimate itself. Undoubtedly contractors would estimate it in a different way from what I have done; different contractors would have different methods of estimating, just as different engineers would have. My point of view in making this estimate is that it is my estimate of what I think the work could fairly be built for under normal conditions, giving a normal compensation, a normal profit to everyone who had to do with the work.

I cannot say whether it is the kind of an estimate that the contractor who got the job would figure out in making his bid. If plans

were to be made for these reservoirs, and bids were to be gotten, I am speaking from experience with a great many bids, you would get say half a dozen bids, and they would not bid the same amount, and 7267
the highest bid might be twice as high as the lowest one. Different contractors would figure in different ways, and reach different results. Some of them would figure very carefully, and some less carefully, a good deal less carefully than I have done. If it were a responsible firm that took the contract, they would have to execute it if the contract was drawn so that it could be enforced. The construction of the work would develop the fact of whether the contractor, on the basis of his analysis, was going to make money or not. Different contractors would proceed differently. I cannot say whether a contractor who had undertaken to construct these city distributing reservoirs would make an analysis of what his labor cost would be, or his material cost would be, or how much he would have to pay for forms, or whether he would simply take the cost of a job somewhere else and apply it as a direct basis for his estimate, rather than as a check on it.

I do not think that there would be any general rule on the ques- 7268
tion of whether an estimate, based upon an analysis of what the probable cost would be, in the light of the contractor's experience, would be of any higher degree of probable accuracy than an estimate which was based wholly upon the basis of what another job cost him somewhere else. It might be better, it might be worse, depending upon how directly the other jobs that you refer to are to the one in question; the more nearly it was comparable in all parts, the better it would be as a direct basis for estimating. Every difference that there is, except that of distance, such as different conditions of labor, climate, material cost, possible labor efficiency, and so on, increases the difficulty of the comparison, and tends to reduce the accuracy of the result. I do not see that distance comes into that, because that is not one of the conditions that affects the work. As far as available, I 7269
think the cost of work that is in the neighborhood of San Francisco makes them more useful than if they were at a considerable distance.

Mr. Searls: Mr. Newman gave some completed costs on the cost of placing concrete in walls on the Fort Mason Tunnel. The cost to the contractor, without the cement added, was about $4, and with the cement added it made $6.50; with the cement added to the contract price it made about $8.50. He also testified that the concrete 7270
culvert work done by the Southern Pacific all over the state in small jobs of a few yards did not cost them more than $8 or so. Wouldn't those local figures have any influence at all on your estimate?

Mr. Hazen: You will have to take those up, I think, by item, because there are different ideas presented. In regard to what you say about Mr. Newman, and which I did not hear, the question relates to the alleged cost of the work to the contractor.

I should want to know whether the supposed cost of the contractor was what the contractor said it cost him, or whether it was what Mr. Newman supposed that it cost the contractor, because I think there might be a discrepancy there, and I should be disposed to exclude from my consideration evidence of that kind. I do that after mature consideration, because I have had my resident engineers try to keep the cost of work, done by contractors on a good many jobs through a great many years, and it is my belief that a conscientious careful man in the position of resident engineer will habitually overlook important items of expense, and while his estimate may be useful and helpful, it is not, in my judgment, ever to be taken as a measure of the actual cost of the work that is done, so I should exclude that,
7270-7273 and consider only the contract prices.

Referring to the Fort Mason Tunnel job, with respect to which Mr. Newman testified that the contract price for placing the concrete in walls was $6.50 a yard, and that the cement was furnished by the Commission on the Belt Railroad, at $1.64 per barrel, making the total cost $8.14, which included the cement: This is an instance of a contract let for concrete at $6.50 a cu. yd., excluding cement. The other conditions are not known to me in detail. The State bought the cement at a special contract, at a price not available to ordinary buyers. For the purpose of this rough comparison I shall assume that the cement will cost $2 a barrel, and that for comparison that 1¼ barrels per cu. yd. would be used, that being about the average amount that I would use in my own work for ordinary structures, and I believe also to be the average amount used in the Spring Valley
7274 structures, as far as I have been able to get at it. On that basis, the cement would cost $2.50 a barrel, and adding it to the $6.50 makes $9 per cubic yard. This was a selected case; obviously it is one of a large number of contract prices. I don't know what the others are.

Anyone in active business must have had a great many contract prices; I can give you hundreds of these from my own office, and I can select very low ones or very high ones, but to select low ones would not be fair, and to select high ones would not be fair; one has to look at all the experience there is to get a fair result. In this case the broken rock might have been close at hand; the sand might have been close at hand. The forms might have been easy, or they might have been difficult, I do not know about that. Personally, I would not give an instance of that sort, without knowing more about it, very much weight in considering the local price of concrete, but here, adding the cement to the price that you gave me, I get $9 a cubic yard, and my average for the concrete in the city system is $10.50 a yard, and under the circumstances, that does not look to me like a very wide difference. The fact that the Belt Line did not go into the place of the work would certainly affect the cost.

The use of these comparative costs as a sole basis for analysis is a dangerous method of procedure where the comparison is not a fair one. I have to determine whether the comparison is a fair one in making the estimate, as well as I can, in my own mind, and it is 7275
an exceedingly difficult thing to set adequately all that I know about it. It is an impossibility, but I think I have tried, in using the data and experience that I have, not to pick out any special case of high cost, or low cost, but to keep in mind all the data that I have. My opinion as to the cost of this work is derived from my general experience and study of the particular location and conditions, and all the data that was available to me, and that was helpful.

Whether the particular jobs to which I have referred as being a sound basis for estimating the cost of the work here should be taken merely with the differentiations which I have mentioned, is not for me to say. I have done my best to give you a fair estimate of the cost of doing the work. Whether I make a credible statement on it or not is for others to determine; I cannot do that.

The cost of the Oakland Reservoir I did not know at the time I 7276
made this estimate, but I did afterwards examine the property of the Peoples Water Co., and I examined that reservoir, and saw a record of what it had cost, and if I had it at the time I made this estimate, I should have taken that into consideration. Those records show a cost somewhat less than that which I used in making up my estimate, but on the other hand, the site on which that reservoir was built was extraordinarily favorable. The Spring Valley has not built a reservoir on as favorable a site as that in the city, and I don't know of any site in the city that it could have got to build such a reservoir on, and I think that had something to do with it. It certainly had a great deal to do with the cost of the reservoir, and something to do with the unit prices on the earth works that were involved. As far as the city tanks and reservoirs are concerned, I regard that evidence as very significant, and to the point, because the reservoirs which the City of San Francisco has built are, in a general way, comparable to some of the structures for which I have made estimates.

If I had estimated those structures at the prices which I have 7277
used in making the estimate for the Spring Valley structures, the figures that would have been reached would have been far below the actual cost of the structures as paid by the City of San Francisco. So that as far as that data is concerned, and I think that is the important part of the whole data, my estimates are on a much lower range of prices than the prices actually paid by the City of San Francisco. That is based on a comparison of the totals, and not on a comparison of the unit prices.

I do not think it is fair to compare a reservoir built near the top of the Twin Peaks with a Spring Valley reservoir, where accessibility is comparatively easy, without making an allowance for the differ-

ence in conditions. I believe there was some reinforced concrete in this Twin Peaks construction, and that would have to be accounted for. There is no large job of concrete work, ordinarily, that there is not some part of it that has form work that cost as much, and frequently more than $4.50 a yard.

7278 In estimating the frame work in the construction of the Spring Valley reservoirs, I made estimates directly for the Spring Valley structures, and obviously I have not attached any particular importance to this one item of forms which you have mentioned, and which I never heard of until yesterday. I did not make separate allowances for forms on the different items of work. In other words, I did not estimate it directly.

7279 The probable quantity of work in the way of forms, and so on, which you will have to do in a particular structure that you were valuing, are taken into account in my estimates in this way: I am carrying in my mind when I estimate the concrete for a structure, a certain base price, which, perhaps is not a matter of record, and does not appear in these estimates, and when it comes to particular structures that involve more form work, or that are more difficult in any other way, I estimate a higher price per yard for those structures as I see them, and so the prices that I have put on the several items of work in the same job are not uniform. I increase them, or decrease them with the ease or difficulty of the work. I can, to some extent, carry in mind the quantity of forms that were used in these various eastern reservoirs which I have cited as being comparable. I do not carry it with sufficient accuracy to make a very accurate comparison, but to make a general comparison, I think I can.

The Central Reservoir costs, as compared with Spring Valley costs, is one item. You get high items, and low items, and it seems to me that this is a low item. Mr. Wilhelm, I find, estimated the cost of this earth work at 55 cents a cubic yard, which is either 1 cent or 2 cents more than Mr. Dockweiler gave with the trimming added. I estimated the earth work on the University Mound Reservoir, which was most nearly comparable, at 65 cents per cu. yd. in comparison, and I am of the opinion that the Central Reservoir is

7280 an easier piece of work than the University Mound Reservoir.

Questioned by Master.

It was in a natural depression. The reservoir was largely built by nature, and the work consisted in excavating out a limited amount of material to form the basin, and putting that on a dam across the lower side only. It was largely downhill work, taking the material at the top down to this depression. Of course, the last of it would be uphill, but a very favorable situation.

Questioned by Mr. Searls.

That would affect the quantities very largely, and it affects the costs more greatly than it affects the unit costs, but if the material,

as I think, is easy material to handle, and if the proportion of uphill haul is less, and downhill haul is great, that tends to reduce the cost per cubic yard. In that I am speaking of earth work. Mr. Wilhelm's figure on concrete, I think, checks exactly Mr. Dockweiler's. I do not know how that concrete was made; whether it was as good as the Spring Valley concrete or not. As far as the concrete was as good as the Spring Valley concrete, if it was, and they built it for 7281
$8.50, it tends to indicate that my estimate was too high.

Mr. Dockweiler: Their mixture, I should say, is about the Spring Valley mixture. It runs slightly over a barrel and a quarter to the yard. The sand there came from the E. B. & A. L. Stone Co., but I do not remember where they were shipping from. The cement cost them $2.20 a barrel, and rock 87½ a yard; $3.75 a load delivered, 2-yard load. The rock came from a quarry in Oakland. I know the team made five round trips a day, and the material delivered cost $3.75 a load, which was a 2-yard load. The charge was so much for 7282
the rock at the job.

CROSS EXAMINATION BY MR. SEARLS.

Mr. Hazen: I have no record to show that the haul in that Central Reservoir was about 1,500 feet for the bulk of the installation, but I should say not, from memory. On your statement that the record in evidence shows that there were 130,000 yards, haul 1,500 feet; 65,000 yards, haul 450 feet; 14,000 yards, haul 600 feet; 13,000 yards, haul 1,400 feet; and the estimate of haul at University Mound, it is somewhat greater, but I don't know how that was figured. From an inspection of the two reservoirs, and my recollection of their size, I should not say there was a very wide difference. I don't know anything about that record, but the haul may be figured in a direct line, or it may be figured by the way that the teams went, it may not have been direct; the same would be true on the others. For instance, on 7283
the College Hill, the direct distance is a certain distance, but you have quite a climb to make; a detour may have been made to have made that climb easier.

Mr. Dockweiler: I don't remember how they figured this haul in the Central Reservoir, but it was not the round trip distance. That was what is called haul distance. Part of this material went into the bank at the lower end of the reservoir, and part went into the upper end of the reservoir to make that embankment to keep the water from flowing away to the north and to Hopkins Street, so it must have been material at an uphill haul, because most of the excavation was done down in the bottom of the reservoir. I saw the construction of it, and I noticed specifically that it was a heavy pull from the shovels. The steam shovel work was done in a manner to shape the bowl of the reservoir so that the shovel was under a handicap, because it had to get out material, and also shape the reservoir,

so they did not have as favorable a run as you would have at University Mound, in my opinion.

Mr. Hazen: I am skeptical about that.

CROSS EXAMINATION BY MR. SEARLS.

7284 In considering work that has been done at contract prices, I do consider, in a general way, whether the contractor lost money, or made a large profit, and that is one of the things for consideration in using the data elsewhere, but it is my judgment that contractor's profit as estimated by inspectors are habitually over-estimated; as far as I know, I think they are always. I think the estimates of the inspectors, or the resident engineers, are always too low, because they are not the contractor. As far as the contractor is concerned, they are a visitor on the work, and they get at all those things they know about, but they do not get at all the things that there are; just as if you should come and spend a week in my office, and estimate what the expense of running my office would be for a year, and you might make a fair approximation of it, but the chances are, if you filed a detailed schedule, and put in what you thought the expenses were, your estimate would be too low.

7285 I will agree that there may be a situation where an inspector might get a very good estimate of the cost of a piece of work. I cannot say from experience whether the office overhead of the average contractor is, or is not, a very large percentage. I didn't go into the particulars of the cost of excavation as done by steam shovel, Fresno scrapers, or graders. I assume that it would be done by the cheapest method that was available; if it was done by the contractor, that the contractor would select the method that he thought he could make the most money by following, and no doubt his contract price would be based upon his assumption as to the method that he was going to use. Different bidders would make different estimates.

In order to determine whether a contract price on another piece of work is comparable, I do not think it follows that you would have to know whether that was done by one method or the
7286 other, because the same piece of work one contractor would do cheaper by one implement, and another contractor would do it cheaper by the other. It depends upon their system. Contractors frequently do work cheaper by the system that has been used and which has been followed than he can by another, and it does not follow because he does it cheaper in that way that somebody else could do it cheaper in the same way. There is no uniform rule that
7287 steam shovel work is cheaper than work done with scrapers; scrapers are cheaper in places, otherwise they would not be used. A few steam shovels would be used for a good deal of the excavation in some of these reservoirs, at least, because they would do the work cheaper. If a man used bad judgment in using Fresno

scrapers, where a steam shovel would have been more economical, to that extent there would be a condition for consideration in using those figures. I would not exclude grader work as possible in these city reservoirs, but I have not thought of graders being used. I remember that Mr. Noyes gave some very low figure on the cost of excavating a reservoir near Vallejo with New Era Graders, and I won't say that it would be impossible to use such graders on some of the larger reservoirs here. I don't know whether it would be uneconomical, as I did not consider that.

If I were going to make an estimate for the construction of a 7288
reservoir in California, I should take everything I could get into consideration, and there is this general consideration that would influence my judgment somewhat: California is a State of great resources. It has taken a great many years to open the State up, and the people have been ambitious; they wanted to do a great deal with a little money, and that desire has led, often times, to doing work less thoroughly, and taking chances that would not be taken on Eastern work. I think a great deal of the California work that I have seen, and that I have learned something about, has been done in a less thorough way, and at less cost, than some of the Eastern work that I have used in comparison. I believe that Mr. Schussler's work, from all that I have seen of it, has been done every bit as well as the best Eastern work of corresponding times; and to take that work which has been proved by actual experience, these reservoirs are tight, and have withstood the earthquake, and met all the contingencies that there are—and to measure the cost of reproducing those structures by the cost of the cheapest work that you can find, the temporary California work, I do not believe it is giving the old work a fair deal.

Of course the art has been developing, and Mr. Schussler, many 7289
years ago, did not know the things that he knows today, and I have considered that element particularly in depreciation. I considered it in reproduction to the extent that I figured on replacing brick work with concrete in various structures, and some other matters similar to that. Where the whole art has changed to such an important extent that it seemed to me it really would not be quite fair to figure on the exact reproduction of the original structures, where there is something else that is ordinary practice now that would perform exactly the same service in the same way, and could be built at less cost, I have considered that in the reproduction. Generally I have reserved that consideration for depreciation.

The earth excavation at University Mound is very much more
per cubic yard than at the Sunol Filter Galleries. The Sunol work 7290
consists in simply taking off the top dry material, and piling it up along side. I do not think that it is comparable at all to the work involved in building a distributing reservoir. It was practically no

haul; very short haul for some of it, much of it no haul. The principal difference is not in the haul, as I think there is quite a difference in the excavation itself, although the haul is part of it. I am inclined to think that a steam shovel could work easier in gravel, such as is found at Sunol, than it would in the material at University Mound. The material at University Mound is not hard material to handle, I think, but it would cost more to handle than that sandy gravel. If the Sunol excavation was narrower and shallower, it would be comparable, as far as handling the material is concerned, but this Sunol excavation was so wide, it would not be possible to put in a machine, and take out the material and dump it in place. A small excavation at Sunol could be done for less for excavating and dumping than a larger one.

7291 In digging a trench, for instance, or a drainage ditch, a machine will go along and take the material and pile it on one side, or both sides. I have done work of that kind in the last year, and it can be done very cheaply, indeed, with a machine; it does not involve any handling of the material at all. Assuming that instead of digging it that way, that the work was done with scrapers, and had to be hauled out of the ditch for a distance varying from 10 to 30 feet, and deposited in a pile, it might, or it might not be comparable.

The price that should be added per hundred feet due to the difference in the length of haul depends on how it is hauled; whether it is wheeled with wheelbarrows, carts, or cars. I think Mr. Dockweiler gave an estimate of a cent per 100 feet extra haul, and I think that is a reasonable rough figure. On that, figures would be found higher and lower. I cannot say whether that is common railroad practice, but I think that is a fair estimate for the purpose of this discussion.

Questioned by Mr. Greene.

It would not depend much upon the size of the vehicle that is taking the load; it would depend upon how good the road was, or how bad, and it depends on that a good deal.

7292

CROSS EXAMINATION BY MR. SEARLS.

Mr. Hazen: At University Mound I assumed a haul of 700 or 800 feet on an average. College Hill, I think, would not be more than 300 or 400 feet; on Lake Honda I made no assumption. I think the material there would have to be taken off the site in large part, and disposed of outside. I don't know how long that haul would be. The matter of hauling downhill a few hundred feet and filling up these soft spots that Mr. Elliott was telling us about yesterday, is a matter of some expense. A few hundred feet may turn out to be one or two thousand, and it is not the easiest thing in the world to fill up an old pond by dumping sand in it.

Mr. Elliott: We have consistently refused to allow any dumping on the waste pond that belongs to us, because our main outlet pipe goes through the bottom of it, but on Seventh Avenue, which 7293
passes through a part of this pond, the excavation from the Lake Honda station has been dumped. I suppose it would average 1,500 feet from the center of the Honda Reservoir to the center of the pond, and from Lake Honda to where they dump the material from the Twin Peaks Tunnel the distance is about the same.

CROSS EXAMINATION BY MR. SEARLS.

Mr. Hazen: I did not get any figures as to the original cost of excavating College Hill Reservoir.

Mr. Searls: I will state that the Minute Book B, November 15, 1870, shows the contract was let to Hancock & Kelso, at 32½ cents per cubic yard. That was for the College Hill Reservoir excavation.

Mr. Hazen: I have seen old contracts where there was one 7294
price for the material delivered, and someone else, perhaps the company itself, assumes responsibility for placing and rolling the material in the dam. I have no reason to think that applies in this case, but I have seen such contracts.

I did not look into the matter of where the clay was procured when these reservoirs were constructed. I was unable to determine where the clay in Lake Honda was laid. I have heard that it was over the concrete floor, and I believe, from inquiry that I have made since, that is correct, but I did not know that before I made the estimate. If it was simply a layer of clay over the floor, I don't know that it would make any difference in the cost of reproducing it that way. I would not reproduce it that way again if I were starting at the bottom. There is a figure of $2.50 a cubic yard for that clay in the appraisal. Apparently the puddle was necessary; the bottom was put in, apparently, with concrete, hoping that it would be tight, and apparently it was not, and the puddle was put on afterwards to make it tight, and apparently it did make it tight. I think I used $1.50 a cubic yard for puddle in the trenches, where 7295
the clay was obtained on the ground, or in the neighborhood, and $2.50 where I had no reason to think that the clay could be so obtained. I think probably it would cost a little more to lay the clay out in layers on the floor of the reservoir than it would to puddle it in trenches. I presume that you would have to tamp and ram it hard, as I certainly tamped and rolled it when I placed it in a reservoir bottom, and I do not think it is easier to do it there than it is in a trench. These trenches are rather wide affairs, and are brought up with the dam, and the material is quite easily placed in them.

The puddle is so soft that I have never placed puddle that a steam roller could go over. It might be that it would be possible

to place it dry and roll it, but that is something I have never looked up. The idea of the puddle is to have it rather wet, so that it will quake when it is rammed, and that is the way it has always been done, so far as I know.

Questioned by Master.

7296 Many old reservoirs were built without concrete bottoms. The particular reason for the concrete bottom is to facilitate cleaning.

CROSS EXAMINATION BY MR. SEARLS.

I should say that it would cost within reason $37\frac{1}{2}$ cents approximately to handle the water on the Lake Honda excavation. If there are 104,000 odd yards of sand there, that would mean about $39,000 for taking care of the drainage of the reservoir, in addition to the cost of the pipes, and so on, that are included in the inventory. That strikes me as a very moderate estimate. The taking care of the water is a very bothersome question, and is imagining conditions that, of course, have been existing for a great many years, and that we know very little about, but we assume that we have an outlet that goes into the lake, and that it is capable of lowering the water for a couple of feet more than the floor at the outlet; assume that is done, and you dig a ditch from that out to the lake, you drain off the water above that level, that is, at that point, but further back you have the saturated material with the water that is in it, and the water that comes in from the rainfall on the sides, and you have saturated material to work with, and if you try to excavate that saturated material and get it out, you would have practically quicksand to work with; you could not do it. If you tried to do it, you
7297 could not do it for 75 cents a yard, nor $1 a yard. In order to drain it, you have got to get some kind of drainage to intercept the water that is coming in, and make the whole thing dry down a distance of a foot or so below the foot of your excavation; that might be done by driving wells around and pumping. I think that would be the most likely way of approaching it. It is a way that I have used sometimes in handling excavations of that kind, but there would be other ways of doing it.

You could pump water out of quicksand where you could not drain it, but there might be difficulties in doing that. Where I have used wells, it has been a little coarser sand than this; this sand is very fine, and it is hard to get wells in it. It might not be possible to get wells in it. I think there are some small water courses in Lake Honda, and there is undoubtedly ground water coming in from the dune sand on one side of the reservoir. The water that came in in regular streams around the job could be diverted, probably. It is the ground water that would be the most perplexing. I happen to have quite a little experience in excavating sandy material where it is wet, and if the thing is not very carefully handled, it runs into

money very rapidly. I think the sand excavation at Lake Merced —referring to the trench at the south side of the lake—was all dry work. We struck ground water in the tunnel a little lower, but 7298
I don't think that is quite to the point.

I understand there was puddle lining used in the construction of some of these reservoirs in the city, which served the same purpose as puddle core, but is put in somewhat differently. The face was lined with puddle instead of putting it in the embankment. That is common construction where the embankment is not too high. At University Mound, the material which was put in in the agreed inventory as macadam, was used, and it is my assumption that that material takes the place of puddle; I am inclined to think the name macadam is unfortunate. I do not think it represents the material. It was local material, and I do not think perhaps it was truly classified as puddle, but it was more nearly like puddle than macadam, and took the place of puddle in this reservoir. I think that was put in there. I assume that was put in dry and rolled, different from puddle in that respect; it was a stiffer material, with clay base, and rolled in, instead of being puddled in wet in the usual manner.

I took an average of $10 a yard right through at Honda. Rub- 7299
ble masonry covers a very wide range of construction, and it is put in at all sorts of prices. I made these figures on that as it looked to me. I don't think I could account for the difference at the different places, but some of it is a great deal better than others.

As to whether, if I were building the Lake Honda Reservoir today, I would reproduce the center wall, that is a hard question. If Honda was not there, I do not believe you could build it there, because the country would have developed so that it would have ceased to have been a possible reservoir site. If it were to be built, it is good practice to build a reservoir in two parts, with a dividing wall, so that the parts can be used, either one, with the other out of service. That is what these reservoirs are built for. Whether I should do it or not, I do not know. I should think about it a long time.

Mr. Elliott: Since I have been with the company, we have never been able to empty it, because we needed the water too badly. It supplies 21 or 22 millions daily, and has a capacity of only 35 mil- 7300
lion. I never saw the water lowered in the reservoir. I can say, from hearsay, that Mr. Schussler does not consider that wall safe, and that is all I know about it.

Mr. Searls: The wall is included in the gross amount of concrete: Center wall 558 yards, item 5.

CROSS EXAMINATION BY MR. SEARLS.

Mr. Hazen: With respect to the Potrero Heights Reservoir, I did not pay much attention to the classification of the rock. I esti-

mated on what I thought was a fair price for the material, as I thought. That is, I took the classification as evidence, in general terms, and not limiting my judgment as to the difficulty of the material represented in the different costs. Of course, it is soft rock, as all the rock in San Francisco is soft as compared with the rocks of the Sierras and other places, but I took loose rock to represent rock that has been shattered up, and could be excavated with some use of a pick, without the use of powder. The rock at this reservoir is not in that class; there probably was a little loose rock at the top, but the bulk of the excavation, as I saw it in my judgment, is just as compact solid rock as would be found anywhere on this peninsula.
7301 I could not see it as it was originally. The whole top of the hill is rock, and the streets are cut through it, and they were making an excavation for a building right alongside that I saw, and that is a place that I could trust my own judgment. If anybody said to the contrary, I should still be inclined to believe what I saw.

Mr. Elliott: In that inventory, as far as the classification of rock is concerned, we called everything loose rock that was broken, or had seams in it; that covers a pretty wide range. The loose rock in Potrero Heights is not the same as the loose rock over at Francisco Street, or at Lombard Street. They were both called loose rock for the purpose of the inventory, but that simply meant that they were not one solid mass of rock. When Mr. Ransome and I agreed on the inventory of the structures of the company within the City of San Francisco, we had in mind that this was a general classification, and that the various men who would appraise these things would naturally visit the ground. It was more a general description than anything else. Of course, when you refer to loose rock or earth, then you mean a decided difference; earth covered everything that had no rock in it, but had clay, and all sorts of things.

7302 Mr. Dockweiler: I think it is a soft rock, and that Mr. Elliott will agree with me on that. I think soft rock more probably describes it than loose rock, because I saw that same work going on that Mr. Hazen refers to. I think they were building a fire engine house right across the street.

7303 Mr. Dillman: I never visited the Potrero Heights Reservoir site but once, but I have worked under a great many specifications made by others, and have made specifications trying to define loose rock in the specifications. Possibly the most common definition of loose rock in specifications runs about this way: It shall include all masses of rock detached, rock under a cubic yard, or sometimes half a cubic yard; also all soft rock, shales, and sandstone; cemented gravel; that can be moved without blasting, though blasting may be occasionally resorted to. They tried to cover a large range of material which lies between earth, which is entirely friable, and solid

rock which requires blasting. It generally includes material of this kind, which would be soft rock. Under the ordinary specifications, this would be classified as loose rock, being soft rock in place; it is not loosened, except a little at the top, I think.

Mr. Hazen: I do not object to the classification "loose rock" in this case, but in my judgment if it is loose rock, it nevertheless will cost a good deal more per cubic yard to excavate it than some of the other loose rock in the system. My figures as to the original cost of this reservoir, I think, are taken from the Municipal Reports, 7304
and were made by the Spring Valley Water Co. to the City of San Francisco at the time the work was done. I never had the information as to the cost of the Clarendon Heights excavation made in 1894, being 38¾ cents.

Mr. Searls: I took that information from the minutes, but I have not the reference here.

ONE HUNDRED AND FIRST HEARING FEBRUARY 21, 1916.

Witnesses: R. Lassere for Plaintiff.
Allen Hazen for Plaintiff.
G. A. Elliott for Plaintiff.
Geo. L. Dillman for Defendants.

Witness: R. Lassere for Plaintiff, in rebuttal. 7306

Lassere

DIRECT EXAMINATION BY MR. MCCUTCHEN.

I am 48 years of age, reside in San Jose, and have resided there for 30 years. I am in the butchering business, and am familiar with a good deal of the land back of Calaveras, which is used for grazing purposes. I have bought cattle from that range for about 7 or 8 years for the purpose of butchering them for the market. I took the cattle directly from the range to the slaughter house, and had them slaughtered immediately. The beef from that range is very good beef. I generally buy about 400 or 500 head of cattle from that range each year. 7307

CROSS EXAMINATION BY MR. SEARLS.

I have bought my cattle from Will and Sam Parks, Lee Ozier, Dorgan Brothers, Al Stone, Blanch Brothers, and Hubert, and several others whose names I can't recall. I generally go out on the range and buy the cattle.

Questioned by Master.

I could not say whether all these men that I have mentioned run their cattle on the Spring Valley lands in Calaveras Valley, or not,

but I think they all have some of that land; they may own part of it, and rent part of it, I am not sure. I understand that the Parks Brothers rent all their land from the Spring Valley Co.

CROSS EXAMINATION BY MR. SEARLS.

When I go out to buy cattle I generally go on horseback and
7308 select my cattle. The Blanch Brothers keep their cattle on the range east of Mt. Hamilton, I believe.

Mr. McCutchen: I do not think all these people range on the Spring Valley property. There are some he has named that are new to me.

CROSS EXAMINATION BY MR. SEARLS.

Mr. Lassere: When I go out to buy cattle that way sometimes I know when I am on Spring Valley ground, and sometimes I do not. I buy cattle on both the east and west side of Calaveras Valley. I could
7309 not say how many I buy from the different sides, but I could say how many I buy, I think, from each individual. I think the Parks Brothers run their cattle on the east side. The first year that I ever bought any on the west side was last year when I purchased some from Parks Brothers. Mr. Parks ran some of his cattle on the west side last year. I believe sometimes he brings these cattle into the valley during the winter, but not very many of them; sometimes they do that to save feed; that is usual if they can get cheap stubble somewhere, all the ranchers generally do that. I have purchased cattle about the month of April, and I have purchased not a great many
7310 earlier than that, and they were very good cattle at that time.

Questioned by Master.

I have never bought any cattle in the winter earlier than April at any time in the Calaveras.

CROSS EXAMINATION BY MR. SEARLS.

I know that in some years Parks has brought cattle down into the valley, and other years he has left them on the hills all the year round. I have seen them on the hills. I don't know whether Mr. Parks runs any cattle on the Crocker-Dillon land or not.

I understand that some of these people that I have mentioned run on the Spring Valley, but I have no idea of the section on which they run. When I purchased cattle from them, I found their cattle
7311 scattered all over the country. There is the Bain place and Brannam place. There are places all along the line. I do not know where the Brannam place is.

I made purchases on the Williams Ranch. It is on the east end
7312 of the Calaveras, and I think is where Parks lives. In making these cattle purchases I went east and northeast of Mt. Hamilton, and made purchases of all the people that I have mentioned here. I do not

know the Priesker place. I went on to property to the east of Alameda Creek in making my purchases, and I have been on the hills to the east of that. I believe I have been still farther east than the crest of that Alameda Ridge. I could not say whether the cattle which I have bought are gathered from land, some of which belongs to the Spring Valley, and some of which does not.

Questioned by Master.

I bought some as far east as the Mocho, and I know that we got lots of cattle out of the Mocho Creek.

CROSS EXAMINATION BY MR. SEARLS. 7313

The cattle that I bought from the Mocho Creek looked very good. They may be from the Spring Valley land for all I know, but they were good cattle. The cattle are about the same all over that range of hills. I did not make any segregation of the cattle that I purchased from the Spring Valley lands so as to be able to judge them in comparison to the cattle which I acquired elsewhere.

Questioned by Mr. McCutchen.

I market my beef in San Jose.

Witness: Allen Hazen for Plaintiff. Hazen

Mr. Searls: I have personally examined the Twin Peaks Reservoir contracts, and have submitted the originals to Mr. Hazen. They show that a contract was originally let in the form of two basins, with an earth wall between, for a lump sum of money. Nowhere in the contract is any segregation made of unit prices. The specifications for concrete are practically all for reinforced concrete, steel bars. The original contract was let on the 20th of January, 1910, and the sup- 7314
plementary contract on the 6th of December, 1911.

Subsequent to the time the original contract was let, Mr. Connick, of the City Engineer's staff, concluded that the earth wall between the two basins was not of the proper strength to support the water in case they should want to empty one basin, and a new contract was let calling for the entire removal of that earth wall, and the substitution of a reinforced concrete wall between the two basins. That greatly increased the cost of excavating. There was a lump sum in both cases, and no indication of unit costs in the original contract. That was the reason we did not attempt to introduce them in evidence, except that we had the City Engineer Inspector's analysis of some of the contractor's costs, and I believe Mr. Dockweiler knew nearly the cost of mixing and placing. The rest of the concrete work was reinforced concrete, and we did not know how we could use it as comparable. The total cost of that work is given in the contract, and as far as I know, it was done within the contract price.

7315 Mr. Hazen: The whole cost of the Twin Peaks Reservoir was $200,674.99. The payments under the first contract were $153,088.33. Under the second contract $19,500, and for repairs and incidental expenses $29,961.56, and from that was deducted one-half the cost paid by the contractor for the services rendered by outside engineers in reporting upon the serviceability of the reservoir, so that there is a credit item of $1,875, and that makes up the total.

Mr. Searls: I presume those figures are correct. In connection with the repairs and the expenditures, these were the result of the discovery after the completion of the reservoir, and after it was filled with water, that there was a serious leak there, caused by the specification of joints in the reservoir, and filling these joints with asphalt, or something of that sort, and instead of making it a monolithic structure, the joints were not impervious to water, with the result that there was a leak, and a great deal of extra expense incurred.

7316 Mr. Hazen: I spent most of my time since Friday on the question of the Central Reservoir in Oakland; the cost record and its analysis, and what it represented, and I have had Mr. Wilhelm's co-operation in doing that. The work covered by this record is only part of the construction of the reservoir, and I think that ought to be in the record, because when I first saw these figures of Mr. Dockweiler's, I thought something was wrong with them, as my estimate of the cost of reproducing the reservoir was so much greater, but understanding that this covers only part of the cost, the record seems to be all right.

I have these sheets of Mr. Park's that Mr. Dockweiler used, and I went through the expenditures and classified, and reached a result
7317 that checks very closely with Mr. Dockweiler's, being within a couple of thousand dollars on the earth work, and closer than that on the concrete, so I will accept his classification on that, and will use it as the basis for all the calculations that I make.

The material at the Central Reservoir, as I could see it in the cuts that are now open, which, of course, might not be just the same as they are in the reservoir, but which give a general indication, is not just the same kind of material as the material in the University Mound Reservoir, being quite a little different, and there is not any very strong presumption that the cost of handling one would be the same as handling the other. At the same time, both of them are easy materials to handle, and I do not believe the difference is a very wide one, so that I believe that a comparison in general terms, and bearing in mind this is not precise, is a fair one. The difference of haul in the two cases, using Mr. Dockweiler's haul, and my estimate for University Mound, I think rather exaggerates the difference, as I have looked at them both since Friday, and without going into calculations, I do not believe the difference in haul was as great as the increase from 800 or 900 feet at University Mound to 1500 feet at Central Reservoir. That is simply based on my judgment, after looking

at the reservoirs, and comparing them in my mind, and after looking at the plans with Mr. Wilhelm. I think there is some extra haul at Central Reservoir, but not as much as that difference.

Questioned by Master.

I suspect that the 1500 feet represents the longer haul at Central 7318
Reservoir, and a good deal of the material was hauled for a shorter distance, and at University Mound, as I looked at it again yesterday, it seemed to me that perhaps the average would be a little greater than I first estimated it. I am cognizant in making that statement of the fact that Mr. Dockweiler's figures were taken from the engineer's monthly report at the time of the construction.

Mr. Metcalf: I figured the weight average of the haul, at the last session here, and that is very much less than 1500 feet, and is the average length of haul in all of the earth work handled, and my impression is it is over 1100 feet. I am referring to the entire haul. The steam shovel haul was about 1400 feet, as I remember.

Mr. Hazen: As far as this discussion is concerned, the weight 7319
average is the fair thing to use.

Mr. Dockweiler's costs of concrete are $8.50 a cu. yd. That does not include the expansion joint, which is part of the concrete, and which cost on his figure here $5,405. That would amount to about 39 cents per cu. yd. and that clearly ought to be added. In connection therewith, at University Mound there are also expansion joints corresponding to these which are included in the cost of concrete, and following the older practice, there are 4 times as many of them as there are in the Central Reservoir, so that the 39 cents which was allowed for the expansion joints in the Central Reservoir would indicate a considerably higher amount for the expansion joints at University Mound, and should be included in making the comparison.

I did not make a separate allowance for expansion joints in the University Mound. I always include appurtenances of that sort as part of the main structure. They are not included in the schedule, but they are in the reservoir; they are a part of the concrete.

The finish of concrete at Central Reservoir and University Mound 7320
is entirely different. The University Mound Reservoir concrete was finished smooth with screeds, and by that I mean there were boards on either side, and a straight edge was hauled across, resting on the boards, to smooth it to a smooth surface, and then it must have been finished by hand, with trowels, in the way that it used to be done, and still is done in many reservoirs. In the Central Reservoir the concrete was simply dumped in place, rammed, and left rough, no smooth finish at all. That, in my judgment, would make a difference, perhaps, of $1 a yard in price; so if we start with $8.50, Mr. Dockweiler's figure, and add 40 cents for the expansion joints, that brings it up to $8.90 as the actual cost of the concrete in the Central Reservoir; adding $1 for the difference in finish, brings us to $9.90, and we still

have the extra expansion joints in the University Mound concrete to account for, so I am inclined to think that instead of showing a much lower price for concrete, it shows a pretty good check on my figure.

Questioned by Mr. Greene.

The stone that was used in that concrete came from a quarry directly back of the reservoir, and that would tend, of course, to a cheaper lump cost than if it had to be taken from some quarry farther distant.

7321 CROSS EXAMINATION BY MR. SEARLS.

Mr. Hazen: I don't know that the fact that it cost \$1.87½ plus 15%, according to the schedule, affects the general proposition, if it had been hauled farther, it probably would have cost more. I do not think the price on rock that I used at Crystal Springs would be generally applicable on this system. That was for a very large quantity—160,000 cu. yds.—to be taken out at one quarry near the work, which permitted a large and economical plant, and I do not think that one could count on getting rock at other places in smaller quantities for that figure, or one approaching it.

On the earth work I find that the 237,000 cu. yds., on which Mr. Dockweiler's calculation was predicated, was made by adding up these quantities on Mr. Park's sheet, which represents the inspector's estimate of the amount of earth moved as it was moved, with 11,000 cu. yds. added at the end, that 11,000 yds. being the amount of trimming that was done preparatory to placing the concrete, and it is represented in cost by this item of \$10,610 in Mr. Dockweiler's schedule. Then the material was not measured; apparently it was simply estimated that they moved about a yard for every dollar that they expended, and rounded it up to the \$11,000, so these figures are in the inspector's estimate of the material moved as it was moving, and includes every yard of material moving in any way through the cost of construction. After the work was completed, Mr. Wilhelm measured the cut and fill with these results: The cut was 213,766 cu. yds., and the fill was 217,180 cu. yds., and with the 11,000 yds. added for
7322 the trimming, and using an approximate figure which Mr. Wilhelm gave me, you get 227,000 cu. yds. as the estimated amount of material actually moved, in place of the 237,000 which Mr. Dockweiler used.

I think the inspector never could tell by estimating how much is used, and the cross-section, after it was done, is the only test. As the inspector only made an error of 10,000 cu. yds., I think he was an extraordinarily good estimator. If the 10,000 yds. had been the actual estimate of the engineer in charge of the work at that time, his opinion would not be apt to be more accurate than a cross-section made after the completion of the work. These contours were all taken before the work began, and Mr. Wilhelm has the cross-section, showing the elevation of the ground at every point before the work started, and

what was done at different times, and the amount at completion of the work, and these are the figures that he had on file as part of his records. The first estimate was made of the material as it was moved 7323
in carts or cars, and he allowed so much per cart or per car for the material that went out, and it came out 237,000 cu. yds., and measuring it with the estimates afterwards it gave 227,000 cu. yds. The material in place should be taken as a basis always in estimating the cost per cu. yd., and that is uniformly done, as far as I am aware, except as provisional estimates are made as the work progresses, subject to correction later, on the other basis.

Questioned by Mr. McCutchen.

The difference between ground in place and loose ground might be called shrinkage.

Questioned by Master.

The figures that we have in the agreed inventory in this case are for excavation in place.

CROSS EXAMINATION BY MR. SEARLS.

I add this 11,000 yards to my cross-section, because that is the estimate that is made, and that appears on the record in Oakland, and Mr. Wilhelm added it, and I accepted it. That 11,000 yds. represents the amount scraped off the sides in one place, and put somewhere else, and my cross-section would not take that into account if it was scraped. I add that to my cross-section estimate, because the 7324
cross-section did not include it. The cross-section, Mr. Wilhelm thought did include everything but that, and then he added this 11,000 yards to what his cross-section showed to get the total amount of material moved.

Mr. Wilhelm put some of his assistants on to measure up this section, and compute the amount of rolled embankment that had been built on this reservoir, and he gave me the result this morning, which I will give. Of the 227,000 cu. yds., 31,000 cu. yds. were material that was handled twice; that is to say, the steam shovel ran into the banks to get a cut, that they could work economically, further than the finished section, and afterwards they broke down the banks from above, and filled in this extra excavation, and this also includes the 11,000 yds. of trimming, so that there is 31,000 yds. of material included in the 227,000 that would not be shown by a measurement of the reservoir made in the way that the University Mound Reservoir was measured, and deducting that, it leaves the amount of yardage of the Central Reservoir, and measured in the way that the University Mound was measured, as I understand it, of 196,000 cubic yards. Of this 196,000 cu. yds. only a part was rolled. In going over the sections in 7325
the way that I have talked with Mr. Wilhelm on Saturday, and which his assistants have done, he thinks that on the north end of the reservoir there were 16,000 cu. yds. of fill that was not rolled; on the south

end 7,500 cu. yds. that were not rolled; a total of 38,500 cu. yds. that were not rolled. Deducting 38,000 round figures from 196,000 leaves 158,000 cu. yds. of rolled embankment that can be accounted for in the Central Reservoir.

I am trying to get this record on a basis where it will be exactly comparable with the record of the University Mound Reservoir. In both cases there was an excess of excavation, and some of the material went into rolled embankment, and some of it went outside. Now, to
7326 estimate the Central Reservoir, using the unit prices that I have applied to the University Mound Reservoir, we have 196,000 cu. yds. of excavation at 40 cents, which is $78,200; and 158,000 of that rolled at 25 cents additional, $39,500; a total of $117,900. The actual cost, as deduced by Mr. Dockweiler, adding in the item for trimming, is $124,789. In other words, the actual cost of this earth work comes out $6,889, or 5.8% more than the amount that is reached by applying the unit prices that I use on the University Mound Reservoir to it. It seems to me that his examination is substantially correct, and if it is not, we are prepared to go into it further, and show what the facts are.

7327 CROSS EXAMINATION BY MR. SEARLS.

I made the same study of all the eastern concrete prices that I use as a comparative basis. The costs of eastern concrete that I use were on work that has been carried out under the direction of our own office, and I know how the records of the office have been kept, and how these figures were made up. I have not said that each of those structures was exactly comparable with the Spring Valley structure, and I think I have, in particular cases, indicated quite large adjustments of the contract prices that I used. I do not think that they have always been additions; they have been more frequently additions, because generally the cost of doing that kind of work is greater here than it is in the East.

Questioned by Mr. Greene.

This analysis would indicate that the cost of the Oakland work was 5.8% greater than I estimated for University Mound, which would be, adding a little over 2 cents to the 40 which I used for general excavation, 42 cents, and not quite 4 cents to the 65 cents for the excavation and placing in embankment, making it about nearly 69
7328 cents. As confirmatory evidence I will say that Mr. Elliott went through these sheets independently, and he reported to me that on these sheets themselves it appears that 58,550 cu. yds. of material was not rolled. That is, taking the items where there is no roller in the payroll, and that does not check exactly the figure that I got from Mr. Wilhelm, but it is not very far from it. It is a little less; I don't know that it follows in Mr. Elliott's calculation that every time where a roller is given that all the material was rolled, but he made that assumption in his separation.

I have made some inquiry in regard to the Fort Mason Tunnel, and I found what purports to be a description of the tunnel and its cost in the "Western Engineer" of March, 1915, and I have made this rapid calculation from the figures as they are reported. There were 12,980 cu. yds. of concrete of all classes placed in the work. The payment therefor, at contract prices, was $98,407, an average of $7.57 per cu. yd.; the extras and bonus on the work amounted to 7%, and that, I think, should be added pro rata, and amounts to 53 cents, making the contract payment for concrete $8.10 per cu. yard. That does not include the cement. Adding cement, as it would be in the Spring Valley work, and not as it was in this work, a barrel and a quarter at $2 a barrel, $2.50, makes the average price of the concrete on this work $10.60 per cubic yard. If any comparison is made, I should think that is a fairer one to use than the one that was suggested. I also note in this contract that the earth excavation was paid for at the rate of 60 cents per cubic yard, 7329
the earth backfill at the rate of 60 cents per cubic yard, and rock excavation at the rate of $1.25 per cubic yard, and they would all be subject to the 7% increase for extra work, if it is adjusted pro rata, and if the index on the cost of concrete is of any value, perhaps the index on the cost of excavation would be equally useful to us.

Questioned by Mr. Searls.

That is open cut excavation. The tunnel excavation cost $76 per lineal foot. The concrete included the arch and the side walls and portals, and the retaining walls of the tunnel arch. I do not think that placing the concrete in an arch is a fair comparison of any item in this concrete. I think that wall work, other things being equal, is a good deal cheaper than reservoir lining per cubic yard, and I think the top is more expensive than reservoir lining per cubic yard. I am inclined to think that the average of the whole would perhaps be a better indication than the cost of the cheapest item. The tunnel lining by itself would be a little more than $10.60 per yard. I have not figured it that way. This tunnel lining was specified from 2 feet 3 inches to 2 feet 9 inches thick, averaging about 2½ feet thick, and it is in a large cut where cars could run through, and the tunnel was near the surface, so that they bored holes down, 7330
according to this account, and shot the concrete through the holes into the roof, and, of course, concrete could be put in any tunnel lining in a large tunnel, and in these masses, at a cost that could not be approached in small tunnels. There would be no comparison at all. I further note that the amount of yardage paid did overrun the theoretical quantity by 25% in the arch, and 10% in the side walls. It was both rock and sand; rock at one end, and sand at the other.

This is taken from a copy of a staff article in "Western Engineering", dated March, 1915, page 382. I do not know whether

these figures are correct or not, but as far as they go this checks Mr. Newman's testimony precisely. The cost of $6.50 that he gave is what is given here, without the cement, and without allowance for extra work.

Questioned by Mr. Greene.

Referring to the Central Reservoir, Oakland: The weight aver-
7331 age applied to the whole quantity gives the absolute average haul of all the material in the reservoir; multiplying the weight average by the whole quantity produces the same result that is reached by multiplying the haul for each quantity by that quantity, and adding up those products; I think that is a fair way to average it.

Questioned by Mr. Searls:

I assume that they would use the most economical means of excavating in University Mound that were available. I do not know whether they did or not.

I talked with Mr. Wilhelm about what the contractor was paid for his equipment rental, with 15% added to that. All my information was second-hand, but the steam shovel at a rental of $50 a day, which has been mentioned, was a very large steam shovel, and the rental naturally would be in proportion. I did not make other inquiries, outside of the inquiry from Mr. Wilhelm, who believes the work was as well managed as could be reasonably anticipated. This
7332 was a 72-ton shovel, 2½ yard bucket.

Mr. Ellis: The usual rental for a 40 and 50-ton shovel is $25 a day, and that is what we paid.

Mr. Hazen: On the first page of this Park's memorandum I see where I was in error. Mr. Parks says, though, it was a 70-ton Ducyrus shovel, with a 2½ yard bucket.

Mr. Ellis: I am familiar with the equipment rental which was charged during the same period, and the equipment charges are all uniformly very high. I was renting the same class of equipment. Mr. Dockweiler tells me it was not exactly a cash proposition, and possibly that would account for the fact that they paid such extreme rentals for all sorts of equipment. They were paying $9 a day for four-horse Fresnos, and then 15% on top of that. At the same time we were paying $7 for a four-horse Fresno, and 7½% for force account percentage, and the contractor had to keep all the equipment in repair at his own expense, and was not allowed to keep any stock during idle times. In this contract, apparently, the company takes care of all repairs, and makes an allowance for idle stock.

7333 At the place where the steam shovel rental I spoke of was concerned, I think the shovel was in use about a year. In regard to the stock matter, it was on another job, as was also the Fresno rentals; we had two-horse wagon rentals for which we paid $5 as against their $6 here. It was a shorter period of use than in this case. I think it was over a period of 10 months.

Mr. Hazen: One clause in this contract provides: "Charges "for machinery and implements are not to commence until they are "in operation on the job, and thereafter no charge is to be made "for same when not in operation".

Mr. Ellis: But all stock is paid for; there is a separate charge here for the feeding of all stock during idle times amounting to \$1500 or \$1600, so they paid 75 cents a day for feeding all the stock. We were paying \$5 for two-horse teams, and 7½% on top of that for force account percentage. We were doing this work at Daly City at the County Line.

Mr. Hazen: The allowances that I made for excavation at the University Mound Reservoir, figured on the total amount of earth work, counting all the material once and only once, is 48½ cents per cubic yard, and at College Hill the coresponding figure is 65 cents per cubic yard. I looked at the materials of the two reservoirs yesterday, and it confirms my earlier judgment that the material at College Hill is much more expensive material to excavate that at University Mound or at Central Reservoir, and that it cannot be directly compared with those. 7334

(Counsel for Defendants stated that he did not care to have Mr. Wilhelm produced, and that he had no objection to this statement of Mr. Hazen's on the ground that it is hearsay).

(Counsel for Plaintiff stated that they reserved taking the statement of Mr. Searls with respect to Twin Peaks Reservoir as evidence until they had a chance to go over the contract). 7335

Witness: G. A. Elliott for Plaintiff. Elliott

CROSS EXAMINATION BY MR. SEARLS.

I think I made this appraisal of the city reservoirs the latter part of 1913, and the first part of 1914, and about two months ago I went over them all again, and changed some of the figures, but without making large changes.

At the time I went around the system with Mr. Hazen, and showed him what we had, I did not discuss, and I have never discussed any costs with him, except to tell him what cost data we had in our office. I think you will find that my figures are not identical with his, except in the case of University Mound. It seems to be true that we both used \$2.50 for clay puddle. I am not particularly 7336
familiar with the cost of laying clay puddle. After making a thorough search in the city to find clay puddle, I could not find a sufficient quantity, and I assumed that we would have to get it in San Mateo County; as far as the cost of excavating it is concerned, it is comparable with excavation in clay, of which I have done a great deal, and then it would be a matter of hauling it from there into the city, and placing it into the reservoir. The excess cost

comes from the fact that it comes from outside of San Francisco. If it were in San Francisco, it would be very much less. I did not confer with Mr. Hazen in preparing that figure. All of these figures that I have put in here are my own figures, and what I thought I could do it for myself, based on my own experience. I was not influenced.

There was no steam shovel work on the Deer Creek Forebay. It was a small reservoir, the embankment of which was placed by scrapers, plowed and wet rolled. That is not the forebay above the Rome Power House. It is above the Deer Creek Power House, about 12 miles from Nevada City; the Rome Power House is nearer to Grass Valley; it is on the South Yuba. The Deer Creek Power
7337 House is up toward Banner Mountain. It was built more to the east of Deer Creek than to the west, on top of the ridge down which the pipe line comes to the power house, a sort of a round knoll. The material was what you would call good excavation. It was not rock, and it was not necessary to use powder. We were able to plow it without any trouble. It was rather a small job, amounting to about 13,000 yards. They had to run a construction camp there, as they were constructing not only the forebay, but a pipe line and a power house in addition. I think the cost of moving the equipment on and off that job would be considerably greater than any of the city jobs. It was a pretty good road from Nevada City to the Deer Creek Forebay at that time. It was a fairly good country road, but of course, does not compare with our city streets. In the equipment that we
7338 used there, for instance, the roller was home-made, and the only equipment that was brought in was a plow, the scrapers, and the water wagon.

That work was done by the company itself. I made no segregation of the various prices in that cost. That 70 cents was the over-all cost. That is not over-all cost, the direct cost to that work; it does not include superintendence, engineering, and all those costs. I charged up to that work the cost of making the roller, the home-made work. The roller was simply a concrete cylinder, with a piece of pipe through the middle of it, and didn't cost very much. If it would have been cheaper to have brought it in, we would have done so. We had to buy feed for our stock, but I could not say now where it came from. I know it was hauled from Nevada City, but I don't know whether it was brought from there, or came from a greater distance. The haul from Nevada City was not entirely uphill; the difference in elevation was not so great between the two places. The ditch that runs up Deer Creek runs down to Nevada City on an ordinary ditch grade, and in 12 miles that would not amount to a great deal. You have the ordinary up and down road there. We
7339 used to make it with a two-horse team and buggy in about an hour and 15 minutes.

I think there is a ditch running from the middle of this forebay down to Nevada City on grade. It may go to Grass Valley, but I know that water up there used to go down to supply some of the mines in that neighborhood, because we used to have trouble on account of the interruptions. I do not know what time the freight teams made in hauling up our feed.

That was a 12,000 yard job, as compared with 208,000 yards in University Mound, and I would expect the price to be somewhat higher there. The only difference is that the hours were longer at Deer Creek than they are in San Francisco. I figure on 8 hours in estimating my San Francisco work. Of course, there is nothing that would prevent you working longer than 8 hours, except the unions. I never tried to work crews longer than that, but there is one thing 7340
that you have to keep in mind, and that is, we are a public service corporation. I have been with the Spring Valley Water Co. since 1909, and several times I have had considerable trouble with the unions; we have got to avoid that sort of trouble. For instance, we laid a pipe on Bryant Street some years ago, and we wanted to rivet that pipe, and Schaw-Batcher gave us a price for riveting up the joints that was based on the union scale of wages for boilermakers at that time, which was $4. After the men started, and found out that it was for the Spring Valley Water Co., they demanded 50 cents in excess of the ordinary union scale. Of course, there was no reason for that at all, excepting they thought we had to have the pipe; that is an extraordinary case. They usually do not demand any more than the union scale, but it shows you how far they will go.

Questioned by Mr. Greene. 7341

We had to give the job up, and do it with lead joints.

CROSS EXAMINATION BY MR. SEARLS.

Our riveting was done by skilled labor, and I do not think that in San Francisco that is any different a matter than hiring the kind of men that run a scraper or do the excavation work. For instance, we have laborers at the yard, and have had ever since 1909—there may be four or five men on a team going out to do the work; the laborer generally drives the horse home at night, and if he only works 10 minutes or 15 minutes over 8 hours we have to pay him overtime; he gets $2.50 a day; the same class of men that we would use elsewhere here. That is our ordinary maintenance crew.

You would not have any construction camp here in San Francisco. I do not think you would have one at University Mound. There are car lines very close to University Mound. I do not think that they run a construction camp at the west portal on Twin Peaks Tunnel, although I do not know about it. I have been out there, and I have not seen it. On the Central Pumping Station, which is more

inaccessible, as far as the ordinary working man is concerned than
7342 University Mound, we used no construction camp.

I have had some experience with tunnel work at Calaveras, but the material is not the same. We do not have to classify our material at Calaveras, as we are not building the same sort of embankment. The Calaveras Dam is being built by the hydraulic process, and you get your clay puddle there by a water selection. The slopes on the outside require nothing but weight, and the outside slopes are what we are putting on with the steam shovel, so that we put it in any way at all, whatever is most convenient. For all practical purposes, the great bulk of the steam shovel fill you would call rock, but as a matter of fact, if you would take the material in the bank and analyze it, you would find it was about half rock and half clay. The rock comes in rather large pieces, and as far as handling is concerned, we would probably call it rock. It is sandstone, and would be listed, I suppose, as a soft rock, and would probably come
7343 in the category of loose rock. We have to use powder on it, but it is seamy. The material on which you use powder is not necessarily classified as loose rock; there is loose rock and loose rock, and it is pretty hard to give any specific definition. You would nearly always use powder on hard rock, but the converse does not follow, that where you use powder it takes a hard rock classification. I have used powder on earth and on clay.

The Lake Arthur Dam excavation was a small dam. I got the figures from Mr. Martin, who was superintendent of construction. That job was done by the company. The figure of 72 cents I got myself by getting the total yardage and the total costs assessed against that bank. I don't know what these total costs include, only from what Mr. Martin said, that they included a pro rata of equipment, and the labor up to the foreman. I know the equipment they used, but I don't know the amount of money that was allowed for equipment; that is just the total. I think that information is helpful in making an analysis of what it would cost to build in San Fran-
7344 cisco, in view of the fact that I was on the work so often myself. I only know what the costs were from what Mr. Martin gave me. I suppose I was on that work seven or eight times for a couple of days at a time while it was going on. They used scrapers and wagons, and plows, but no steam shovel. I think the reason the steam shovel was not used there was because they wanted a selected material. It would be dearer in that way than with the steam shovel, and the process of selecting the material would also increase the cost. The material was a sort of a reddish clay; it is that typical red material that we have all through the Sierras in the region of Grass Valley, Auburn, and Colfax. There were some isolated pieces of rock which they saved to rip rap; that was all; there was very little shooting. When the work was laid on the dam it required that it be

laid in layers and rolled, and this 72 cents included the cost of rolling. The same process was not used there that I figured on using 7345
in constructing the University Mound Reservoir. I figured on a steam shovel at University Mound, and I would do what selecting I could. I would not give it the same care that they gave it at Lake Arthur, or at Deer Creek, because you are not depending entirely upon your bank at University Mound for your tightness, although I would try to make it just as tight as I could.

Undoubtedly this method of selecting and rolling materials increases the price. I have heard of figures that were down as low as 7 and 8 cents for embankment work; you can do some sorts of work very cheaply. I was not trying particularly to compare the costs of the Lake Arthur Dam with the costs in San Francisco. I simply said that this was my experience, and I had this in mind in estimating the University Mound Reservoir. I don't think it would be safe at all to try and compare the costs of one of these jobs to University Mound directly. They influenced my opinion as to the way in which the work would have to be done, as to the cost of it, and as to the methods. If I were dealing with different material, 7346
to be constructed in a different way, and under different conditions, they would never have influenced my judgment at all. It is not true that with respect to this they were different material, different way, and different conditions.

I could not say that if I had a figure of 65 cents for excavating and embankment here, and it was 72.2 cents at Lake Arthur, and I used that, that I had some method of resolving one to the other. If I wanted to do that, I would have to use the same method exactly that they used at Lake Arthur, and simply change it by hours, and rates of payment, and all that sort of thing. I suppose in doing that I would probably reach a figure of 90 cents or $1 at University Mound.

I should say that Lake Arthur is 6 or 7 miles from Auburn, the town they worked out of, and there is a station on the railroad called Bowman, which is probably two miles from the dam. The roads are good. It is the state highway, and although it is not like the state highway in San Mateo County, it is good enough for automobiles. That is the road from Auburn to Colfax. 7347

I do not know what the equipment charges were in this 72.2 cents. I do not know all the details that go to make it up, but they would not change my way of using them at all. I don't think anybody could take these factors into account but somebody who had seen the work as it went along. For instance, if I had never seen this work until after it was entirely finished, and they told me it cost 70 cents, it would not mean a thing to me, because I would not have known how they did it, or any troubles they had, or any particularly easy things they had on the work. If I had seen the work as it went along, and

obtained the total cost in this way, it would, to me, be a considerable indication of all the factors.

On the Drum Forebay they started out with a steam shovel, and finished with scrapers. It was very much the same material, with the exception that there were a great many loose nigger head boulders
7348 there that they had to remove from the interior of the reservoir, and waste them outside, which increased the cost considerably. The equipment used in constructing the Drum Forebay was probably obtained in San Francisco. It was shipped to Orel by freight, and then the cars were transferred to another track, and run right into the forebay. They had a private line of railroad in there. They had the power house, the pipe line, and quite a bit of work to do, and it paid them to build the line. This 74½ cents does not include a part of the cost of constructing that railroad, because this 74½ cents is again the direct cost, just up to the foreman. I do not include anything above the foreman in any of these costs that I have given. I include equipment applied directly to the job, but I do not include the equipment that would have to be pro-rated to two or three different jobs; part of that railroad ought to be charged against the power house, the electric installation, and the pipe line, and some against the forebay, but I have not those figures at all; I have not gone up as far as that in my analysis. The mules and things that went directly into the work are included in this 74½ cents.

I think the contract that I mentioned in my direct testimony as not comparable, because it was a hard time contract, must have been
7349 in connection with concrete at Lake Honda. That was the contract for raising the wall about 6 months ago. The contract price per unit, from memory, was $9.15. That was for a certain amount of concrete, and any additional yardage that was placed, was to be placed at $10 a yard. The contractor had to do everything under that contract; build the walls, and furnish the equipment and materials. I do not know what price he paid for cement, but I presume he paid the full market price. The contractor did not go broke on the job. I think, really, that contractor was particularly anxious to establish a connection with the Spring Valley Water Co., and that was why we got that figure. It is considerably lower than three other bids that we had. I don't know whether he got out with a whole skin or not. The whole thing only amounted to about $6,000, and if he lost it all, he probably would not have said anything about it. The original contract called roughly for 550 yards. Then we added enough extra work to that before we got through to bring it up to about 600.

7350 The equipment in this particular case did not amount to very much. I don't suppose it took the contractor more than a part of a day to take all the equipment to Lake Honda that he was going to use. If he had been going to handle 3,000 or 5,000 yards, he could not have handled that with the same equipment in the same time;

there would have been a time limit. If he had placed the concrete for the whole of Lake Honda at the rate he placed it in this wall, it would take 3 or 4 years, and you would not give that much time; he would have had to have more equipment. That was not a particularly thin wall; it was roughly 6 feet high, about 1 foot wide on top, and 3 or 3½ feet on the bottom. The cost of forms on work of that kind is more than if you had an engine foundation, but that is not a particularly thin wall as far as form work goes, and it is a pretty simple form work, too. I did not get the contractor's costs on that job, but 7351
I have costs that were made up by my inspectors on the job.

I found the part of the costs that our inspector kept track of. It 7352
was a very small part of the work, and was just the addition to the gate house. As to the main part of the work, we didn't keep track of the individual items. The 48 cu. yds. in the gate house is all that we have the estimated total cost of the contractor on. The original contract was for 560 cu. yds. of concrete in place, and it was laid for \$5,050, which amounts to \$9.37 per yard; then with extras and things that came up after the job started, it amounted to 652 yds. of concrete, costing the company in all \$6,519, or \$9.86 per yard. That was field cost, and included the cost of an inspector on the job. Then we had a design of the wall, which is not in it, and which would be classed as engineering.

The figure of \$2.70 per barrel for cement I presume was net. I
don't vouch for the accuracy of that figure; that is the way the in- 7353
spector got it from the man in the field, and turned it in simply as a matter of information. I do not know what it cost to haul the cement
out there per barrel. When I spoke of extras in giving those costs, I 7354
meant extra yardage.

That is all the note that the inspector turned into the office, and it only covers 48 yards out of a total of 570, and I think is not of any particular value. It refers to the gate house wall, which is not one of the more expensive items of concrete construction. The forms for the wall were perfectly straight, and the inspector did not show what the forms cost.

When I stated that my price of \$10 per cu. yd. of concrete was based on the work at Calaveras, I had in mind the lining of the reser-
voir face at Calaveras, which is similar to the one used at University 7355
Mound, and at Lake Honda. Lake Honda is probably a little thicker. That work is on the upstream face of the dam at Calaveras, and averages 5 inches thick. The mix used was 1-3-5, which is an average mix, but makes good, fair concrete.

Mr. Hazen: The explanation of the difference between the 1-2-5, and the 1-3-5 that has been used in many other places, is that with the local rock there is quite a good deal of fine material resulting from the breaking, and that has not been screened out, and it takes the place of part of the sand. The 1-2-5 mix, with the local materials,

approximately corresponds, in my judgment, with the 1-3-5 mix used in other places.

Mr. Elliott: We might really call it 1 to 8; we simply take the creek gravel, and we found by screening various portions of it, that it averaged 1-3-5. As far as that used at Calaveras is concerned, there was no separation at all; we removed the rock that was 3 inches and over in diameter, and used the remainder. The sand was in the gravel.

Questioned by Master.

We finished the surface, but it was not a sidewalk finish. It was more in the nature of what Mr. Hazen calls screeded. We took a
7356 straight edge and lined it up.

CROSS EXAMINATION BY MR. SEARLS.

We didn't get $10 per yard at Calaveras. I used that as a base. At Calaveras they worked 10 hours, and the labor was $2.50. The direct cost of the work, up as far as the foreman, was $7 a cu. yd. in place. There is an auxiliary undivided expense at Calaveras for roads, trails and camps, and so on, of 17%, which should be added to that to give the field cost without overhead. That includes the entire cost of getting the gravel, which we got about 2,000 feet from where we used it. The cement had to be hauled in from Milpitas, and that gives $8.19 per cu. yd., with the auxiliary expenses added in, and on a 10-hour day basis. In this case I made a resolution from 10 hours to 9 hours and 8 hours on a direct percentage basis, not that I thought it ought to apply absolutely, but it came out about $10.30 a yard for 8 hours, and concrete labor at $4, such as you have to pay in San
7357 Francisco. I don't think that is a fair way to do it exactly. I think the difference between 10 hours and 8 hours is not a direct ratio, except where machinery is used, and you have to keep pace with machinery. I have never figured out what ratio would obtain. For 9 hours it would be about half the difference between the $8.19 and $10.30, which would make it about $9.25.

The sand and gravel cost about $2.25 per yard on the job. I could not say offhand how that compares with the cost in San Francisco. The reported cost of the gravel at Lake Honda was $1.80 a yard, and the sand $1.50 a yard, but that does not mean that my sand and gravel would probably cost a little more at Calaveras than they would in San Francisco; a yard of my material up there was equivalent to more than a yard of either sand or gravel here. You would have to say 30% voids in your gravel, so you would have the cost of 1 yard of gravel, plus 1/3 yard of sand, to compare with my cost of $2.17 at Calaveras. It would be about $2.30 at Lake Honda. They are practically the same.

7358 Mr. Hazen: I should say, from memory, that they paid $2.49 for cement on that job, and nominally 40 cents for sacks, but all the

sacks are never returned. I estimated nine-tenths of them returned, which gave me, as I remember it, $2.13.

Mr. Elliott: I can answer as to that that so far 75% of these sacks have been returned from Calaveras.

Mr. Hazen: Probably the percentage returned is less at Calaveras because of the rather hard haul, it gives the sacks harder use than on the jobs for which we more frequently get data.

CROSS EXAMINATION BY MR. SEARLS.

Mr. Elliott: In the last 6 years I did a lot of small concrete jobs 7359
around here for the company, but I don't recall any of the details of them at this time. Some of them have gone considerably over $10 because they were small jobs, and some of them have been less. There were 7 or 8 cess-pools on the Merced Ranch; the water tank at Central Pumping Station; the foundation for the engine of Central Pumping Station; the concrete outlet for the Lake Honda Screen House; and the concrete lining in the Sunol Filter Galleries. The last was done in 1909, but I could not tell you the cost offhand. I
think I could get these figures without much difficulty, but it would 7360
probably be in the nature of what it costs for the whole job, because we did not keep any man on the job to segregate it into the various things. I can get the total cubic yards, and the total cost.

Mr. Metcalf: Mr. Eastman states his price at the foot of page 5826 as follows: "They submitted the same price, that is $2.49 a "barrel f.o.b. cars at Milpitas."

The Master: Mr. Herrmann said at page 5368: "The hauling 7361
"is based on the experience in hauling with motor trucks at Calaveras. "In 1913 we contracted the hauling of cement and other materials, "including a large amount of lumber, from Milpitas to the Calaveras "Dam site, a distance of 9½ miles. The contract price for lumber "was 30 cents per ton mile, plus 25 cents per ton to the contractor "for handling at the cars, and the unloading on the job was done by "the company employees; these trucks were used throughout the 24 "hours in order to hasten the work."

" A truck for a 24-hour day would cost $50 a day if you hired it, "the upkeep being in the hands of the truck owner. Dividing 50 by "124 ton-miles, gives you 40 cents per ton-mile." Further on he says: "Lately in hauling 42,000 feet of lumber from Milpitas to Calaveras "by teams, the cost has been $5.17 per thousand, or 36.3 cents per "ton-mile."

Mr. Searls: I make the total cost of hauling 81¼ cents for the cement in each cu. yd. of concrete, on the basis of 9½ miles, 30 cents a ton-mile for hauling, and 500 lbs. of cement to the cu. yd.

Mr. Hazen: It is 51 cents a barrel, or 71 cents a cu. yd.

7362 CROSS EXAMINATION BY MR. SEARLS.

Mr. Elliott: The 75 cents is per cu. yd. at Lake Honda for hauling, and I suppose that would mean that my hauling cost me more in San Francisco than it did to Calaveras, assuming that the cement costs to haul to Calaveras 71 cents per barrel. I am not vouching for those figures; those were reported to the inspector out there by the contractor, and it does not seem reasonable to me that it would be dearer in San Francisco than in the country.

I did not assume any hauling costs in my figures as to the San Francisco reservoirs. I took a price per yard, based on what I considered average conditions. I would not attempt to analyze my $10
7363 per cubic yard. I have simply taken these other jobs and said that that is about what it would cost. I did not make any analysis on my brick work; that was based on the cost of the completed brick work, principally in those pumping stations I mentioned at the time. The brick work that was done there was boiler settings, and that was all the brick work I ever did. I do not know how the costs that I had there compare with the jobs of which I have heard. I knew enough about it in using the price of $30 per thousand for straight brick work to know that brick work lining in a reservoir or in a tunnel was a much better class of brick work than you put in a boiler setting. It is more difficult work, as a rule. Boiler work is pretty straight work, with the exception of the fire-box. The brick work in the forebays on these reservoirs is in the forebay, but is not the lining of it; some of these forebays are built entirely of brick. The University Mound Forebay is an entirely brick forebay, and that is circular. By the
7364 forebay, I mean the tower that is out in the water; the outlet.

I should think that would be more difficult to lay than straight walls, but I have not used any greater price on that than I have on the boiler work. That costs $27 for common brick, and $29 for hard-burned. I think I have used $30 on the other work for ordinary straight brick work, and I have used $35 on the slopes. I have not had any experience in brick work that enables me to determine the differentiation between ordinary straight brick work, and brick work in the slope. It was just a matter of what I thought it would cost in addition. In addition to my own experience on that work, I had the benefit of some scattered and fragmentary cost records of the company, but I was not familiar with the conditions under which that work was performed. That figure depended more on the boiler work than anything else. The cost of laying the brick in the tunnels was based on a similar assumption.

On my outlet tunnels my figures were based somewhat on Calaveras tunnels, which cost $7.53, which includes such timbering as was necessary to hold the tunnel for 2 or 3 weeks, as the tunnels at Calaveras have generally been built, not for permanent structures, but for

purposes of blasting down the hillside. We never figured on the tunnels lasting more than a few weeks. If I were going to line them I would probably pay more attention to sections, and shape them up somewhat. We did not build the tunnels at Calaveras with the same care as if we were building an outlet tunnel. All we wanted to do was to get at a hole in the middle of a hill, so as to place powder in it, or else to get in and see what the hill was made of. We had a culvert at Calaveras, but I guess it is called an outlet tunnel now, because the dam is built over it; it was built as an open culvert. We have a wasteway contemplated through that promontary, but we have not started on that construction at all yet. In 1913, when Mr. Herrmann started that work, we thought he would have to divert the water around there when they were doing the work. We built a small flume around there; there was no tunnel built. 7365

Referring to the ashlar masonry; I have never done any of that work at all. It is my estimate of what the shaping of the stone blocks that were used, and what the stone masons would cost, together with setting them in place. I have no data on it at all. Those blocks are all of a stone that is foreign to San Francisco, and they are all squared up just as if they were going to be placed in a building such as the new City Hall here. 7366

On the rubble masonry—in connection with work I did for the Pacific Gas & Electric Co. years ago, we had a lot of wall of that sort to build in various places, and we found the rock right on the job; it used to cost us about \$6 or \$6.50 a yard. I have estimated it at that price, plus the difference in cost of getting the rock, according to my idea of it. That brings it to about \$8.

I have not had any experience in placing clay puddle. I have not found any clay in San Francisco, but if there is any that we can get in San Francisco, it will make a big difference in the cost of placing the clay puddle. I have been unable to find any extensive beds of clay that we could get hold of. We find clay in the streets sometimes that would be very good, and I suppose you could find it on the adjoining property, but my experience is that the adjoining property is usually used for something else than a puddle pit. I did not see the clay they went through in the open cut on the east side of the Twin Peaks Tunnel. If that is suitable clay, it would make a difference in the cost as to clay at Lake Honda. I have been to the Twin Peaks Tunnel very often, but I have never seen that, although it may be there. 7367

Mr. Searls: The clay on the east side of the Twin Peaks Tunnel
was in the open cut, running from Seventeenth and Market up to 7368
Eighteenth and Hattie, and various points along there.

Mr. Dockweiler: You will find clay in the Sutro Forest, up through one of those ravines that drain into Laguna Honda.

CROSS EXAMINATION BY MR. SEARLS.

Mr. Elliott: We excavated about 4500 yards of sand at Central
7369 Pump, as I remember it. We just scraped it out of the excavation, and dumped as soon as we got about 35 or 40 feet away. That cost 58 cents a yard because there was water in it, and I made it 75 cents at Laguna Honda on account of an estimated longer haul. The haul at Central Pump was about 100 to 150 feet with scrapers. I suppose that about 1 cent 100 feet is a fair estimate for the increased cost of haul. The only experience I had on that was Lake Arthur. It ran about 1½ cents. I could see where it would be 1 cent in a good many cases. The point at which the material taken out of Laguna Honda portal of the Twin Peaks Tunnel is being dumped is situated about 1500 feet from the center of Lake Honda itself, so that at that rate, the difference between the length of haul at Central Pump and at Lake Honda would be about 1400 feet. I should say the maximum
7370 haul at Central Pump was not over 150 feet. The mean haul is from about the center of the reservoir to about the center of the dump down below. The bulk of the excavating is done on the western side for the entire length, and that would make my comparative cost at Lake Honda a little less than 75 cents if they dumped it where they are dumping the Twin Peaks. If you reconstructed Lake Honda the way it is now constructed, you would have to leave that ground below there in the condition that it is in now. The outlet pipe from the bottom of Lake Honda must be lower than the lake itself in order to drain the lake at all points. We have been asked quite a few times, in the last few years, to allow people to dump there, and we have always refused unless they would build a tunnel over the pipe in order to protect it.

7371 The upper tunnel at Lake Honda is about 14 feet above the floor of the reservoir. The original pipe out of Lake Honda went through the small tunnel at the bottom, and was a 16-inch pipe. So far as I know, it was put in by Von Schmidt in 1864, when the reservoir was built. As the consumption increased, they had to have a larger outlet, and some years ago Mr. Schussler put in this new outlet 14 feet above the bottom of the lake, and installed two 24-inch pipes. That tunnel is a large enough tunnel to take two 2-foot pipes side by side. I have never been in the tunnel, but I should say it is 6 or 7 feet high. I believe I figured that excavation at $8 per lineal foot. There is both concrete and brick in the tunnel. The sewer tunnel, on which I gave a gross figure of $11,305, was built many years ago, and I do not know what the cost was. That figures out about $18 per lineal foot, and includes the lining. I did not figure this as a tunnel, for the
7372 reason that for the last 10 or 12 years the street has been graded right down to the concrete top of the tunnel, so that it would be really built in an open cut if reproduced at any time since 1907, so I figured it as an open cut.

Lombard Street Reservoir, on which I have a tunnel figure of \$8.50 per foot. I cannot give you the size of that tunnel offhand unless it is given in the inventory. One of them is given as 4 by 5½ feet, by 83 feet long. I think a tunnel of that cross-section would be somewhat difficult to dig. The \$8.50 does not include any lining, but would include timbering if necessary. It is solid rock, and the chances are that timbering might not have been necessary. In these short tunnels in the city reservoirs, it is pretty hard to tell what they were originally, because the streets have generally been finished off, and 7373
there is no bank or dump or anything to indicate, and they are all lined, and you really cannot see the material.

Mr. Searls: I have the reference on the original cost of the Clarendon Heights excavation contract: It is dated May 3, 1894, a contract to A. E. Buckman; minute book E, 38¾ cents per cubic yard.

RE-DIRECT EXAMINATION BY MR. GREENE.

The \$2.17 as the cost of sand for Calaveras, and the \$2.30 at Lake Honda, are on a comparable basis.

Questioned by Master.

I resolved my Calaveras cost into Lake Honda cost on 8 hours and \$4 a day. At Calaveras we simply scooped the gravel out of the creek bed, and it came mixed; in other words, you just added cement to what you got out of the creek bed, and made the concrete. If you buy rock or large gravel and sand separately, you have to add to a cu. yard of rock probably 30% of sand in order to fill the voids. If you buy that in San Francisco separately, you have to take the price of a cubic yard of rock at Lake Honda, and 1/3 the price of a cu. yd. of sand at Lake Honda, in order to make a cubic yard of aggre- 7374
gate, which corresponds to a cubic yard of aggregate at \$2.17 in Calaveras.

Questioned by Mr. Greene.

At Calaveras we got our material free, and with a very short haul, and at Lake Honda we had to pay for the material, and had a considerable haul. Probably the relation between the two costs is not as close as \$2.17 and \$2.30. That was very rough figuring. There are a lot of conditions that enter into it. We had a 2,000 foot haul at Calaveras; at Lake Honda I suppose we would have three or four miles anyway of haul. The figure \$2.17 represents the cost of the aggregate at Calaveras of materials for the lining of the dam. That includes the 10-hour day, and \$2.50 a day labor, also.

Witness: Geo. L. Dillman recalled for Defendants. Dillman

DIRECT EXAMINATION BY MR. SEARLS.

The other day I stated two pieces of construction which seemed to indicate a very low cost of shaft excavation and tunnel lining. I

went to Oakdale on Friday, and happened to meet the contractors
7375 who are doing this work. I want to correct both of those estimates. The shaft which I spoke of showed a cost for excavation of 50 cents, which was entirely wrong. I got that 50 cents partly from memory, and partly from the records, but the work included some other work. It included a pumping plant, and a pilot-well. The price on the computed bid was $2,550. Before the work was well started, the plans were changed. The pilot-well was left out entirely, and the original installation of the pump was left out. I remember that this pump was not put in, but I did not remember that in lieu of the pilot-well and this pump the contractor put in a pump to test and clean out the tube-wells that were sunk in the bottom of this pit 200 or 300 feet. The contractor's name is Griffiths, and he lives in Benicia. He happened to be down there, and I asked him how he did the work so cheaply, and he said that it was not so cheap; that it cost him 60 cents, and then he mentioned the pumping plant, which I forgot all about. While the cost is as I have stated, the cost of excavation is probably a good deal more than 50 cents a cubic yard, but how much more I cannot tell, because I cannot find any estimate of the cost of the installation of the pumps and so on, so that so far as that shaft excavation goes I am entirely in error, and I want to change it.

7376 My price on the concrete lining of the tunnel is right. The contract price is cost plus a percentage which is not to exceed $12. I asked what the contractor furnished, and the answer was "everything". The contractor does not furnish everything; he does not furnish the gravel nor the cement; he does all the labor, and furnishes the lumber. What that will cost is unknown to me, or to anyone yet, because the contract is not through. The contractor's statement to me on Saturday was that his work would cost in the neighborhood of $10 for the forms, and the labor of putting it in—everything except the sand, gravel, and cement. That is a gravel mix also. It is not a segregated material. He furnishes the lumber, and the figure of $10 is per yard for the concrete lining. He does not get $12, and have all those things furnished to him; he said on Saturday it would be less than $10. His work is not done yet, and that was simply his statement to me.

Questioned by Master.

Cost plus percentage not to exceed $12 are prices that I cited as corroborative. They were not used directly in deducing any of my prices, but they should be corrected, because they are wrong.

7377

CROSS EXAMINATION BY MR. MCCUTCHEN.

I do not mean to say that the $12 was to include the cost of gravel, sand and cement. The contract was that he was to do it for cost, plus a percentage, and that should not be more than $12 for the labor and the lumber.

I had something to do with a well that was dug for the Livermore Water Co. I think it is only about 22 or 24 feet deep, and it is lined with either brick or concrete. It was not done under my supervision, but I instructed the engineer who did it how to build his curb and carry on the work. I was the consulting engineer of the company at that time. I don't know what that work cost, and I never made any inquiry. It was done by the superintendent of the company, W. H. Bissell, and the engineer was a man named Wiley. 7378
Under my instructions he sunk some wells across the Positas Valley, testing simply the depth of gravel to see where would be the best place to locate a sump of this kind. I was on the site, and I know that the well was dug, and a pumping plant installed which gave good results as long as I knew anything about it. I never made any inquiry to see what the cost of that work was, but I don't think it was very expensive work. I think it cost a couple of thousand dollars or something of that kind. I don't know that the books of the company in that case show that the brick lining cost over $2,000. In sinking that curb, the curb pinched above the bottom and broke in two, and the bottom left the upper portion. I don't know what they did to repair it. This excavation undoubtedly cost more than the excavation at Oakdale, but it was because it was in wet material, and some of it was done with a dredge bucket through water. The excavation at Oakdale stopped when they got into wet material, so that it was all dug by hand; at the same time, that Oakdale work cost more than 50 cents. 7379

Mr. McCutchen: Our information is that the well is 27 feet deep, 12 feet in diameter, brick lined, and it cost $2,089.52, including overhead.

Mr. Dillman: I don't know what it cost to break that curb in two and catch it up again. I have not allowed anything in any of my estimates here for mishaps of that kind, but knowing of that mishap, when I dug this Oakdale well, I rodded the curb so that it could not break. That was the only advantage I took of that information.

I do not know where you would get the clay for the puddling on Lake Honda. I did not locate any clay pit. I assume that clay could be gotten, as I have seen clay at various places on the Peninsula. While I located no pit, I assumed it could be gotten within half a mile. If you could not get it within a short distance, it would increase the estimate of expense on that account. If I had to haul it from San Mateo County, I would add quite a good deal to the estimate. If I were to go down to the localities mentioned by Mr. 7380
Ellis, I would increase it by whatever it cost to haul it. It is possible that I can be mistaken about being able to get clay within half a mile. It might be that you could not get it within a much greater distance than that.

The material, which I assumed would have to be excavated in order to create a reservoir at Lake Honda, would be very easily handled. If it were marshy, and had to be drained out, my estimate
7381 would be materially changed, but I have not assumed that. If that was a lake before it was converted into a reservoir, it would not induce me to increase my estimate of the cost of making a reservoir, beyond the cost of draining it. This old outlet tunnel could very easily be deepened to drain the lake. I have not made any allowance for anything of that kind.

The cost of railroad excavation is comparable to the cost of making these excavations for these distributing reservoirs, with allowances for differences in conditions. Railroad contracts are generally much larger in amount, and are done somewhat cheaper. As far as the excavation itself goes, the loosening will cost the same, but a small job would require a little bit more than for moving on and off this railroad work. As far as the finish goes, that is very like the finish of railroad cuts and banks. I allowed extra for the rolling, which is not common in railroad work; there is some reasonable comparison to be made between any excavation and another excavation, although to compare them directly, and say that because one costs so much, the other should cost so much, would lead one into grave errors at times. The cost of the concrete lining on this Oakdale Tunnel is fairly corroborative of my figures here; the
7382 lining of the Oakdale Tunnel was very much cheaper than the lining of these tunnels, I said the other day, but I have found out that it is not the case, and will not be the case, because lumber and cement costs more in that country, and therefore, lining down there should cost more per cubic yard than the lining of these tunnels.

Presuming the cost of cement there to be the same as in San Francisco, and also the sand and gravel to be what it would cost on any of these pieces of work here, it is my opinion that the cost per cubic yard of that concrete lining at Oakdale would be from $10 to $12 a cubic yard. The contractor tells me that it would cost him about $10, and after that you must add the cost of the cement, and of the sand and gravel, and that will add, per cubic yard, at prices for cement and sand and gravel similar to those that would obtain in San Francisco, $4 or $5 per cubic yard. That would be $14 or $15 per cubic yard as a minimum, and I think they worked their men 10 hours; I don't know. This tunnel that is being lined there is not being lined throughout. It is a very long tunnel, and it is only somewhere near the middle of the tunnel, and this material has to be taken in through a shaft, and then taken in cars from the bottom of the shaft to the places of application. That tunnel lining should cost more per cubic yard, under exactly similar conditions otherwise,
7383 so far as cost of material goes, than it would here.

I have not assumed that there is any difference in hours, and I

do not know that there is. I would work my men in San Francisco 9 hours, and I don't know that they work them any more there. I always work my men 10 hours and sometimes 14 in conducting my work. I had no charge of the contractor's force there, but I think they work 10 hours, but I have some doubt about that. That particular tunnel work was done, not by the hour or by the day at all, it was the contractors that worked right there, station men. They did not employ any men to work for them. I have seen the work going on 7384
many times, and there were 8 or 10 of these contractors in a camp. I have not done any concrete work. I have told about some concrete work being done there, but I do not know how long this contractor worked his men. His name is Edward Malley, and he lives in town. Mr. Malley is doing the work on the lining of the tunnel, and I think he gets his material into that tunnel by taking it into the shaft, lowering it in the shaft to the floor of the tunnel, and then transporting it from there. The material, I think, is delivered to him at the collar of the shaft. The material that he takes into the shaft is delivered to him at the shaft; the material, if he takes any into the end of the tunnel, is delivered to him at the tunnel mouth. It is delivered to him at the most convenient place for his work. The longest shaft is 117 feet; he may use the other shaft, which is 85 7385
feet. The tunnel is 7,000 feet long. The portion of it which he is lining with concrete is principally between those two shafts; there is a little above the upper shaft, but I do not know how much. The purpose of the tunnel is to carry water on a grade of about 8 feet to the mile, and the grade would not interfere with the haul of the materials into the middle of the tunnel. It is very good. The cost of hauling would be the cost of laying track principally, and as it is a small job, it probably would be cheaper to put it down this shaft than to lay this track and haul it a longer distance. He does take it in from the shaft so that he will not have far to transport it. He has a power hoist, I infer, for lowering it into the shaft, but I do not know whether it is a power hoist, or a compressed air hoist. I have 7386
not been out there, and I did not see the work.

I think the Sunol Tunnel could be lined for $10 a yard. I figured about $18.53 a lineal foot on the cost of driving and lining the Sunol Tunnel. I allow $10 a cubic yard for concrete lining. It is not fair to say that is just about one-half of the cost of the Oakdale Tunnel which is now being done by Mr. Malley. Taking his statements of what it will cost at $10, and adding the cost of city prices for other material, making a deduction for the average prices of lumber down there, which Mr. Malley furnishes, his price will not be three-quarters of $20. The lumber there is higher than here. It is probably $6 or $7 higher; maybe $2 more for hauling. It will cost at least $8 a thousand more. The $10 includes his percentage and all. He so stated to me. I asked him what it was going to cost

7387 the district, and he said something under \$10, and that includes his profit.

I have not endeavored to analyze what I would allow for sand and rock in my concrete. I know as much about the cost of concrete work as I do about the different details of it, and probably more. This timbering is lighter than the Malley timbering, because the tunnels are smaller. I don't know whether it runs less per cubic yard of concrete, but I rather think there would not be much difference. I think Mr. Malley uses about $1\frac{1}{4}$ barrels of cement to the yard of concrete, but I am not certain of that. I have not computed the average price for the cement in these works. I think it is \$2 a yard. I think I have figured my base price of cement as \$1.60

7388 when I was making that analysis for Crystal Springs. A barrel and a quarter is a very rich mixture for that kind of work. At Sunol the haul would be shorter than for Crystal Springs, and it would cost something less than it did at Crystal Springs. I don't know what it was, nor have I made an analysis of it. I did not use that Oakdale work, and did not know anything about it until my estimate was done. I cited that as corroborative evidence on my direct examination, but that work did not cost as much as my estimate. I do not think it corroborates my statement as well now as it did before I got these additional facts.

I think, in the light of recent investigations and inquiries, that \$10 is a great deal closer price than I thought it was when I made it. I am not sure but what I would make it \$11 or \$12 today, but I

7389 should not make it \$15 under any evidence that I have. I am convinced that \$10 is a pretty tight price, but I am also satisfied that I could let it today for \$10. Whether I could get the good job done that I would want done for that, I am a little bit in doubt. The contract price on the Malley work is of very great value, but this particular contract is not an ordinary contract at all. If I had a contract with Edward Malley to put in concrete at \$10 a yard, and the work had progressed as far as it has, I would be satisfied that \$10 a yard would be what I would pay for that concrete, but it is not a fixed price contract; it has the name of a contract, but they are simply employing Malley at this percentage to handle the work for that district; they call it a contract, but it is not a contract such as I would let or advise.

I do not think that this Malley work indicates that my figure on concrete work on the Spring Valley tunnels is altogether too low. If it fixes anything in my mind, it is that they have let this contract to Malley at too high a figure. I think they could have let it to a

7390 local man, and in fact I know local men who could have done it at a considerably less price than Malley is doing it for. I think the price was let at a figure somewhat too high, and I think they should have let it at a lower price. It requires no special responsibility to

go and spend money and add a percentage, and get it all back from a responsible concern. I know it is an absolutely imprudent way of doing construction work, and it is evidenced by a great many of the new buildings in San Francisco since the fire on which that method was tried.

I know how the Crocker people do their construction, and they have erected quite a number of buildings since the fire. This is a particular case where this man, while he was a contractor, was practically an employee of the Crocker Estate. There are sometimes men
who act perfectly fair in doing work in that way. The first job of 7391
work that I did in California was done in that way. It is not a good plan. The Crockers don't try it with anybody but Mahoney Brothers, either.

The railroad excavation at 20 cents a cubic yard, did not directly induce me to fix the price which I did fix on the excavation at University Mound. I think there is a great deal of excavation that costs considerably less than 25 cents a yard, and some that costs more, but such excavation that costs that, or less than that, has not all of it been railroad excavation. There are all sorts of methods of conducting excavation work for railroad purposes, plowing and scraping. I think probably a steam shovel could be used to advantage on University Mound. After I got the material out of the bucket, I would use cars or wagons to haul it wherever I wanted it.
I have seen railroad work that is comparable to this where the costs 7392
have not been more than 25 cents a cubic yard. This excavation for the purpose of making a reservoir at University Mound is comparable to the railroad work that I have seen done for 25 cents or less. That is the same sort of work, the same kind of material, the same haul, generally done a little less than that for railroad work, but I have added a price for compacting the earth in the fill; it must be somewhat compacted there, because settlement otherwise from shrinkage would crack the lining of the reservoirs, and possibly start leaks that would be very bad. That is the only difference between this and other excavation, similar work, similar material, and the same amount of bank.

ONE HUNDRED AND SECOND HEARING. FEB. 23, 1916.

Witnesses: Geo. Wilhelm for Plaintiff.
Geo. L. Dillman for Defendants.
Allen Hazen for Plaintiff.
J. H. Dockweiler for Defendants.
G. A. Elliott for Plaintiff.

7393 Mr. Hazen: The expansion joints in the University Mound Reservoir were visible from the surface on last Sunday, February 20, 1916. I took a photograph of them. I might say in regard to that, that the asphalt coating which was put in over the reservoir tends to conceal them, and they are not perfectly apparent, but a close observation shows that they are there, and shows the spacing.

7394 Mr. Dockweiler: I made an examination yesterday, and was unable to discern any expansion joints. There are cracks criss-crossing that lining, and I could not see a single expansion joint.

Mr. Metcalf: I saw them. The diagonal cracks we thought might have been made at the time of the earthquake, because you find them on the two sides, having the same general trend, running in the same direction, but the joints of which Mr. Hazen speaks are at right angles to the sides of the reservoir, running down, parallel lines; you could see them all the way. I do not think that what we term joints could possibly have been the strips of tar paper which were laid down in the asphalt.

Mr. Hazen: It is possible to determine whether there are expansion joints there or not by going out and digging some of it up. I
7395 have never known an important reservoir to be lined without providing expansions joints for concrete, and I do not believe Mr. Schussler would have omitted the usually enforced provision.

Mr. Dockweiler: This concrete was laid in forms, and one piece was butted up against the other, but there are no such expansion joints there as there are in the Central Reservoir, where there was a piece of board put in, leaving a triangular space which afterwards was filled up with asphalt; there are no such spaces there at all.

Mr. Hazen: It may be that there are not spaces in the University Reservoir just like there are in the Central Reservoir of concrete, but the concrete is cut up into these squares so that in the event of settlement or movement the joints will take care of the expansion or movement.

Mr. Dockweiler: That is undoubtedly correct. The cement was laid in parallel strips, and there was no stripping inserted, and afterwards such a strip was run with asphalt, such as is the case with the
7396 Central Reservoir. The point is this: The slabs were undoubtedly laid alternately, and then the forms were taken up, and a piece of tar

paper, or something laid in, and then the intervening slab was filled with concrete. The lining was finished; then the weather being hot, there was placed on top of the cement a coal tar wash, which was allowed to stand for quite awhile. Mr. Schussler explained that time was given for this coal tar to soak into the surface of the concrete or cement, and then with that favorable surface condition prevailing he was able to get an adhesion of the asphalt with the concrete lining; he laid his layer of asphalt, as he explained, on top. Then he laid this tar paper over the asphalt, and with a roller, or something, compressed so that the asphaltum that was first laid was thoroughly absorbed and came through this tar paper; then I believe he laid some more, after he had mopped it first, so that apparently you cannot compare the finished cost of the joints of the Central Reservoir with this, because this is a slab over it all, and hot asphalt was poured into the joints, such as was the condition in the Central Reservoir. There are no expansion joints comparable to the joints in the Central Reservoir. 7397

Mr. Hazen has not said there were, but he said that there should be added to the cost of the concrete lining of the Central Reservoir the cost of the asphalt joints. The asphalt has been separately listed in this record of Mr. Park's, and likewise separately listed in this inventory is the asphalt which is placed over the entire concrete work, so that you have a chance of directly comparing the cost of the concrete work in the Central Reservoir with the concrete work in the University Mound Reservoir, which latter is the more expensive work of the two.

Mr. Hazen: I have no reason to think that the joints in the two reservoirs are the same. They are probably different. The extra coat, I suppose, related to the expense of making this joint, and it obviously is more expensive to place concrete joints in this way than to place them without regard to these joints. The concrete blocks are laid off into these joints, but whether the building paper is in the joint, I 7398
don't know.

Mr. Searls: If this asphalt, which is listed separately in University Mound, covers the cost of making these joints, then you should not add to the cost of the Central Reservoir, Mr. Hazen, the amount of the asphalt shown in the force account there, because it is separately listed in the University Mound inventory.

Mr. Hazen: If that item is for the asphalt filling, and not for the extra work on the concrete, the point would seem to be well taken. I don't know whether that is the fact or not.

Witness: George Wilhelm for Plaintiff. Wilhelm

Questioned by Mr. Dockweiler. 7399

In making the joints for the concrete lining of the Central Reservoir, the cost, as we have it segregated, for the asphalt joints, was the

cost of the material, and the pouring of the asphalt into the cement joints which had already been prepared. I am not absolutely certain whether the little triangular board that was put in to prepare the triangular space into which the asphalt was poured was included in the cost of the concrete work, but I think I could probably tell by looking at my force account.

(The witness was permitted to look over his force account, in order that he might be able to answer positively as to the expansion joint, and he was excused temporarily for that purpose.)

Mr. Hazen: If that cost relates to the asphalt, instead of to the making of concrete, I was mistaken in my interpretation, and a correction would be required, but on the other hand, there are approximately four times as many of these joints in proportion in the University Mound concrete as in the Central Reservoir; the cost of
7400 making these extra joints was evidently an appreciable item. I have not attempted to estimate it, and that also would have to be taken into account.

Dillman

Witness: GEO. L. DILLMAN for Defendants.

CROSS EXAMINATION BY MR. MCCUTCHEN.

When I cited the cost of the Oakdale Well at 50 cents per cu. yd. for excavation, I was not influenced by that assumption in fixing the fair value of excavation in the construction of these distributing reservoirs. I have not used that at all. When I put that in as corroborative evidence, I believed that the construction of that well included simply two items, excavation and curbing; that assumption was wrong, and the reason I made the correction is because it is so mixed up with other things that the cost cannot be deduced, either for the curbing or for excavation, from the total figure.

It is my assumption that the depression at Lake Honda could have been so drained that animals could have pulled a full load out of it, and I think it is a reasonable assumption, because the country there is sand, and it is so stated in the inventory that the excavation is sand.
7401 There is no trouble in handling reasonably wet sand, except in the case of its being quick and miry. I took it that it is sand similar to the sand in sight there now. Of course, if the water had had a chance to drain out, it would have drained out, but it would have been held there, even though it were nothing but sand, by dykes, which I understand they cut through. If the water comes in faster than it drains out, it stays permanently wet. I have seen sand drained so that it drained very comfortably with a certain amount of water drained out. I don't know exactly how far below the level of the reservoir I would have placed my outlet pipe. It would depend on circumstances, and I did not go into detail as to just how I would drain

the reservoir. It seems reasonable that the best way to drain that reservoir would be by constructing the outlet first, low enough to do 7402
this drainage, and possibly help that along with tiling and surface ditches. I think the expense of that is estimated in the outlet there.

Questioned by Master.

My estimate is 30 cents for sand. If any special drainage would have to be put in there, it is not accounted for in this 30 cents; if the outlet tunnel does not drain that excavation sufficiently to work it in the ordinary way, then any additional expense for drainage should be added to my estimate.

CROSS EXAMINATION BY MR. MCCUTCHEN. 7403

Mr. Dillman: I don't know how much that might be. I assume the material at University Mound to be earth, all of which could be handled by steam shovels, or plows and scrapers, without the use of powder. The same applies to College Hill. There is no loose rock at College Hill. There is some solid rock at Lake Honda. The loose rock commences with Potrero Heights. I did not assume that the use of powder would be necessary at Potrero Heights, though it might be convenient. I assumed some powder might be used for cheapening the loosening, but not being necessary. As to the 50 cents, the reason for that extra cost is for powder in case it is used, or other methods of loosening that material which is harder than earth, and cannot be easily plowed. The equipment to be used at Potrero Heights depends on the outfit available; the amount is too small to put in a steam shovel, unless you had a steam shovel in your equipment that was handy, and I assume that would be loosened with plows, picks, or powder; possibly some of it by all three methods. 7404

I heard the figures that were given for the excavation of the Fort Mason contract, but I do not remember what they were. I have not examined the work on the Fort Mason contract, and know nothing about that. I have also heard the figures on the Central Reservoir, in Oakland, but I have not examined the Central Reservoir pipe, and do not remember what the figures are. I am not sufficiently familiar with that work to be able to express an opinion as to whether it is easier or more difficult work than the construction of these distributing reservoirs. My prices are put down, not with direct reference to any of these other excavations, but from my general experience and belief that the contract can be let and executed inside of those prices. They are figures which in my belief can be contracted. They are not especially high figures, but they are high enough to warrant my statement that a contract could be let for that kind of excavation, for those prices, to responsible people, and there would be some profit to the contractor. 7405

My allowance for the brick masonry on Lake Honda is $20 a thousand. The brick work there is not hard to lay, and therefore, I

cannot say just where similar brick work is laid. I have seen very little of it done in connection with reservoirs, and I consider that it would be no harder to lay this brick than it would in the wall of a building. I would tell a client for whom brick work of that kind was to be done that it could be done for $20 a thousand. The brick work in the Lake Honda Reservoir is in connection with the piers and slopes. It specifies some in the bottom, here, but I don't know where that is. I think the brick work on the slopes is in connection with those buttresses which brace the slopes, and I include that in my estimate of $20 a thousand. I have put all the brick there at $20 a thousand. I think I would tell a client who wanted work of that kind done, that it could be done for $20 a thousand. If I had that item alone, I would probably look the matter up and know before I told him, just who
7406 he could get to put it in for $20 a thousand. I did not do that in this case. Before I would advise a client with reference to the construction of a brick wall at the corner of Mission and Seventh Streets, that is as to the cost, I would investigate the Labor Union conditions. I did not investigate them in this case. I assume that I would not be bound by the acts of the Union at Lake Honda. I assume that just the ordinary price of brick work, without Labor Union conditions, would exist at Lake Honda, which would enable me to lay brick there for $20 a thousand.

The ordinary price for brick at Oakdale, where it cost several dollars more per thousand than it does here, is $20 to $21 in the wall.
7407 The price that I paid there this spring for brick was $12, if I took it off the cars. I am not sure whether it was $11 or $12, but it was $1 more than if I took them out of the yard. I have assumed the price here at $7, and the hauling as about the same. At that price, the brick per thousand here should be $3 or $4 less than $20 or $21. I don't know what they pay brick layers at Oakdale, or how many hours they work. If I were not hampered by Labor Union conditions, I could lay brick in San Francisco at the same price as at Oakdale, and I could also do it with the same men. I think in all this brick work I have not considered any Labor Union conditions. I have considered what should be done by the employment of competent men, and I have also assumed that with reference to my concrete work.
7408 I have discussed the question of the concrete work with local men, and Mr. Richard Keating told me that my prices are high on concrete. I have not taken up each particular item. Mr. Keating failed some time ago. I think he told me my prices on concrete were high this last fall, certainly in 1913. He failed because he was not paid for some work he had done. He was laying good concrete, and he had been doing it for a great many years. The fact that Mr. Keating told me that my prices were too high satisfied me that they were sufficiently
7409 high to cover local conditions. Mr. Keating did not tell me that his prices were fixed upon the assumption that Labor Union conditions

would not apply. I knew that he understood the local conditions here, and that was the reason that I asked him about the prices on concrete. I went to him after I had made my prices. I told him about the quantities, and I specified especially the Crystal Springs Dam, which was the one big item on the estimate. I did not tell him anything about the other pieces of work. Mr. Keating knew that it was a 4-mile haul to Crystal Springs Dam, as I told him. I did not tell him where I would get sand and rock from, but he knows, because he is thoroughly acquainted with that kind of work, having been doing it a great many years. I do not know whether he ever did any work 7410
in that locality. I did not tell him about the other pieces of concrete work on the system, or the distance for which material would have to be transported. I think we did not discuss any specific piece outside of the Crystal Springs Dam. I did not take his figures for anything. I got the figure that I applied to these pieces of work in San Francisco from my knowledge of concrete work here and elsewhere. If Labor Union conditions imposed anything in the way of output or hours, it will make this work cost more than I have estimated, and on that item, the contractor that I advised to take the contract would make a less profit, or possibly a loss. There are some elements of the work—all the outside work—that I think I could control entirely independent 7411
of any present Labor Union requirements. By outside work, I mean work outside of the city.

I assumed that Labor Union conditions would not apply to common labor. I do not know that common laborers in San Francisco do not work more than 8 hours a day, and I do not know of any piece of work that has gone on in San Francisco where men have worked more than 8 hours a day for the past 5 or 6 years. One can get all sorts of advice to the effect that laborers will do more in 8 hours than they could possibly in 10, but I do not believe it. I believe they can do more than 80% of it, and under proper foremanship, and proper management, I think the reduction of the output will not be in proportion to the reduction in hours at all. In making these estimates 7412
of cost of structures in San Francisco, I knew, in a general way, what labor prices were. I knew what the cost of a great many of these items are in California, and it was on that basis largely that I made my figures. These figures that I have put in here are not directly traceable and logical deductions, from exact premises at all. I don't know how Labor Union conditions are; I have never been hampered with them in the prosecution of work. I know that there are certain requirements by the Labor Unions which are acceded by employers 7413
sometimes, and sometimes resisted, and I know there is a great deal of friction at times over these Union requirements, but I personally have never been bound up by them.

I have heard that there was a limit on output by Labor Unions, and in a general way I know that there are many requirements that

the Labor Unions insist upon being observed in the performance of a piece of work, which requirements would sometimes be observed if Labor Unions had nothing to do with the work, and sometimes they would not. To the extent that one has to deal with Labor Unions, I infer that the work would cost more than it would without the Labor Unions, but on the other hand, I am informed by people who are in favor of Labor Unions that the reliability of labor, the permanency of employment, and the shorter hours, all inure to the benefit of the laborer to such an extent that the actual cost per unit for the work performed, without regard to hours, is practically as low as it is without the requirements, but I do not believe it. I mean that it would
7414 be better in quality, and almost as much in output, and I do not subscribe to that doctrine. From what I have seen, which is small in amount, and from what I have heard, which is considerable, I infer that Labor Union conditions would make work generally more expensive. It does not apply to scraper work, as I do not think there is a Skinners Union.

I think the men on the Peninsula generally work more than 8 hours at common labor. I cannot trace the basis of that information. I take it as a premise, without any direct knowledge. I think Mr. Ellis has stated here that he worked his men more than 8 hours. I never did work a gang on the Peninsula. I don't remember how many hours the Pacific Gas & Electric Co. worked its men on the construction of the pipe line down the Peninsula within the past few
7415 years. I think possibly there is some difference in the quality of the work, and in the cost, whether the company does the work itself, or it is done by contract. There is no difference in digging a trench for a gas main or for a water main as far as excavation and backfill goes. I think if the joining of the pipes is done by the company, it is done a little more carefully than if done by the contractor, and that part of it, I think, would be better for the company to do. The Pacific Gas & Electric Co., and this is from hearsay, and what I
7416 have seen in the papers, would be more apt to cater to the labor union element, and to the dictates of labor, than most other corporations, and any contractor. I think they did that as a matter of policy. The water company's activities are not as extensive, and to that extent, it would not apply to the water company; at the same time, it would apply to the extent that they cared to cater to that element. I don't think it would apply with Mr. Schussler in charge, at all. I don't think there were many labor unions in his time. His work was always exceedingly good, and I am a great admirer of his methods of doing work, and I consider that as a general thing he was right.

I have, in many instances, suggested very much cheaper work than Mr. Schussler did, but I do not think that Mr. Schussler was wrong. Whether a work is built too well, or too flimsily, until the fact develops, must be solely a matter of opinion. If Mr. Schussler

is to be criticised in either direction, it is that he built too well.
That is, he put in more money than would at all times be advisable,
but the conditions under which he worked made his decision to do
the work in the best and most permanent way absolutely right in 7417
all cases, and in putting my prices on here, I consider that you could
build these water works, serving the same amount of water, from
the same sources, for considerably less money than was paid by Mr.
Schussler, or than was estimated in my figures; at the same time, I
have tried to cover the same quality of work that Mr. Schussler did,
in my figures. I said that the mixture which I used at Crystal
Springs Dam might not be as much compacted as Mr. Schussler's,
but of these two blocks of concrete, which have been destroyed, and
the two which I have made, and which we are going to inspect some
of these days, one of them is tamped and rammed until it is as com-
pact as that material can be made, unless it were put under a press
of some kind. It is a great deal better tamped than ordinary con-
crete; the other block is not as well tamped, but is what is known
as a wet mixture, and is simply a shovel tamp. I believe, from the
looks of the two pieces of concrete, that the wet mix is the better
block of the two. The concrete that I propose to put in is as good
concrete as was put in by Mr. Schussler.

My mix is as near the Schussler mix as I could find, 1-2½-5. 7418
That would be 17 lbs. of cement per cu. ft., or 459 to the yard. I
think that is Mr. Schussler's mix, as near as I can make out. I have
taken Mr. Schussler's statement for his mix; he says that he put
in his crusher screenings to increase his fine material, and as near
as I can make it out, that is about the Schussler mix. The 1.24 bar-
rels per yard includes all the extra cement that was used about the
place for connecting old work with new work.

I have not made any assumption as to how many hours the men
were going to work on this work in San Francisco. My assumption
was made on the contract price. I have not gone into the details of
the hours, nor the output. I don't know what the labor conditions 7419
are in connection with this work.

I have not based my figures on what the work could be done
for. I have assumed that I could contract this work at $8 and $9,
and I get that from my judgment of concrete, built chiefly outside 7420
of the City and County of San Francisco. I think I could get a con-
tractor to do it for that price, and under the circumstances that
might prevail in San Francisco, and if union labor was employed,
the contractor would either make a less profit than what I have
assumed when I took these figures, or he might come out with a loss.

In arriving at these figures I have not gone into any detail, but
have reached my conclusions upon what I knew the finished pro-
duct had cost in other cases, but not indefinite cases, because this
experience has gone over a great deal of work, covering a great

many years. I have not any definite record as to the exact cost of different parts of this work, but these prices should do the work with a fair margin of profit to the contractor; they are not very high. I have made these figures as I would make them in bidding for a piece of work; a reasonable figure. I have not gone into de-
7421 tails in order to arrive at my figures. My figures are not from definite premises at all, and I did not have any exact definite single job in mind when I arrived at these figures for concrete work. I had an aggregate of jobs in mind. I have never done much work in or near San Francisco. I have done a small amount on the other side of the bay, but any piece of concrete is comparable to another piece of concrete, if the difference in conditions is taken into account; for instance, in the mix, cost of material, haul of material, cost and haul of cement, and the labor conditions, and the cost of form lumber in place, taken into consideration, they are all somewhat comparable. My way of getting at it is not by determining the number of men that would be employed, and the wages that would be paid them per day, and the quantity of sand, cement and rock that would be used, and the prices of those materials, and the cost of transporting them from the place where they were produced to the place where they were to be used. I presume that an en-
7422 gineer, to get at it in that way, is entitled to just much respect in my opinion, but I would not employ that method myself. Positively not. I long ago abandoned the practice of keeping a record of the cost of other work. When I fixed these prices on concrete, I had no definite piece of concrete work to which these works were comparable, but I had it generally in mind. It makes all the difference in the world whether you have a definite piece, or whether you have it generally. My experience has been in the direction of ascertaining the costs of these works.

My business has been to make preliminary estimates such as this estimate on the cost of a piece of work; generally in much less detail than this inventory indicates, and then to go ahead and do the work, and oftentimes when the work was nearing completion, I would check up and see how my preliminary estimates came out;
7423 sometimes it was bad, and sometimes good; there are always changes in conditions, but as a rule, of late years, my result has panned out fairly well with my preliminary estimates. As far as the concrete goes, the work I had generally in consideration at the time I arrived at these figures, was the work on railroads, canals, and small dams. I have never built a large dam. The biggest piece of concrete work that I have done was at Oregon City, in 1902, I think. I do not remember the cost of cement at that time, or the hours of labor, or the wages paid, nor have I a record of it. I have had experience which enables me to fix these prices. I have been building concrete, and doing excavation and embankment work for a great many

years. I have not used any specific pieces of concrete work for the 7424
purpose of arriving at these figures on concrete. I have not kept the cost of the concrete, but I can go and dig up some from companies' records with which I am in touch, and for whom I have done work in the past.

RE-DIRECT EXAMINATION BY MR. SEARLS.

I commenced engineering work in 1882, practically 33 or 34 years ago. I have not, during that period, uniformly followed the method of estimating that I have indicated in this case. When I began to make estimates my experience was not sufficient for me to know or feel safe in putting down such figures as I have here, but as my experience increased, I cut out the longer methods of analysis, and gradually got down to my present method of estimating. It took me only a couple of days to make an estimate on $2,000,000 worth of varied work on the Oakdale Irrigation District plant, the amount involved is something like $1,000,000, and if I had
to go into these details, as I explained to Mr. Haven, when I was 7425
first employed in this case, I could not take this work up at all, because there was no time; it would have taken me several years to have done this with my equipment, which was not in shape for this. I would have had to have gone into correspondence in a very large way, and this method seemed satisfactory.

I was afterwards shown a letter from Judge Wright to Mr. Olney, I think, saying that the judge had placed considerable weight on an estimate which would point to definite pieces of construction, comparable to these pieces. At that time I went to Mr. Steinhart, and said, "If that is so, you had better drop me from this case". While I knew what these things would cost, and what they could be contracted for, I could not satisfy Judge Wright in this matter. They knew it at the time. The engineers on the other side have known what my views are, and my position in these matters. I have believed that my point of view is right, and I have no fault to find with it yet. I consider it is a good estimate. While in some of these items the contractor might lose money, and therefore the estimate is too low, in other items it is too high, and the estimate, as a whole, is very good, and the estimate on any considerable portion is good, and the work could have been done for those prices.

Referring to the estimate that I made at Oakdale in a relatively 7426
short time: We got many scores of miles of laterals done in excess of what the district expected to do with the first bond issue. That was a very satisfactory result. In a smaller way, the water and sewer plants that I put in at Oakdale had a surplus at the end of construction, which allowed them to build, under the name of a flushing tank, a municipal swimming pool, of concrete, 60 feet long and 36 feet wide. My estimates panned out very comfortably in

the past few years. The bond issue that I mentioned was not based on my estimate; the bond issue was made, then I took charge of the work, and laid out the work of the district, located the ditches, dams, and laterals, and so on; that is the estimate that I refer to as having been made good at the end of construction, and by that I mean that the construction was within the estimate which I made.

Referring to work on the Peninsula; I am satisfied that a con-
7427 tractor could organize a crew on the outside, and bring it in there, irrespective of local union conditions on small jobs, and he could work those men at the agreed wages and prices that he made with them when they were employed. That would be a logical thing to do so far as Crystal Springs Dam goes. It would, in connection with tunnels, flume work, and I think pipe work, although I am not quite as certain about that. So far as the work in San Francisco is concerned, I have no information such as would justify my belief that common labor was not fully organized, or governed largely by union rules.

The price has less to do with the cost of brick work than the amount of brick which is laid. I was informed the other day, and suspect that it may be true, that the number of brick which a brick mason is allowed to lay is so limited that that would make more difference than the price. I know many brick masons that will lay in straight walls 3,000 or 4,000. I would not haggle with a man of that kind over a price, and I know that many of these station men in the heading of a tunnel will take out in soft material as much as an ordinary hobo will in open surface work. I would expect them to make much bigger than ordinary going wages, and they are entitled to it. They are paid then for the work they do, instead of the time they spend on the job, and the basis of organization and
7428 discipline of crews is all in the direction of getting better men and bigger output. There is no objection to high wages if you get the results. The objection is in paying high wages to third and fourth-class men, and it is in that direction, I think, that the unions are tending.

The only object in letting contracts is to introduce to the work a contractor who has, by ability, an initial organization and power to do this work cheaper than the corporation could do it. If they cannot do it cheaper than a corporation, there is no special object in employing the contractor. Corporations have often attempted to do their own work, and except in special cases, have not gotten
7429 good results. A public corporation that can contract their work, as a rule can contract it to better advantage than they can do it themselves. It is always advisable to do it. I think as near an exception to that as I know it in a large way has been the work of Herman Schussler; while I think that he might have paid more for some of his work, it was because of an attempt to get really better work. He

contracted a great deal of his work, and he did it because the Risdon Iron Works, or some of those other people could do the work better than he did, although he had a complete outfit.

I did not assume that Mr. Schussler would be able to act as chief engineer in the reproduction of these works in 1913, but I have assumed that a man of equal ability would be there.

My examination of Lake Honda did not reveal to me any in- 7430
dications which would make me think that the drainage system provided for in the inventory would not be sufficient to drain the water that was found, or might be found there. I have assumed that clay would be found for making the puddle at convenient distances from the structures, but if it were necessary to bring it some distance, I have assumed the increased cost might be for a mile of haul per yard somewhere between 30 and 40 cents; it would cost the same to load it one place as another, and that price per mile would be slightly decreased with an increased length of haul, on account of the cost of loading.

RE-CROSS EXAMINATION BY MR. McCUTCHEN.

The railroads found that it did not pay them to mine coal. I don't know whether the Reading Company, and the Lehigh Valley Company found it paid to mine coal. The Union Pacific bankruptcy was precipitated by the Rock Springs coal operations. I don't know who owned the Rock Springs deposit. It was owned by the Union 7431
Pacific in my time; so with the carbon deposit; so with the Dana deposit; so with the Hanna deposits. I don't think they all failed as coal projects. They prospered as coal deposits, to the detriment of the railroads.

I think that a contractor who was constructing the work on the Peninsula could bring in a crew from the outside, and if he could not bring in a crew from the outside, my figures would still obtain. This is a good labor market, and he would not need to bring them in except in the case of labor troubles. I would not expect any labor trouble. There is no doubt in my mind but what that work might 7432
be carried on on the Peninsula under non-union labor conditions, but I am more in doubt about San Francisco on account of what I have heard here in this case, and the knowledge that labor unions are catered to here to a very considerable extent.

Station men are all contractors, and do not employ anybody. They do all the work themselves. They are very industrious, and are not controlled by any hours. They can put in a days labor in 10 hours, and I do not think they work over regular hours. They work together. I do not think that they observe hours very much. 7433
They are not restricted as to hours. A corporation would not have to be if they could get these specification men to contract their tunnel work to. I am assuming that a corporation, doing work of this

kind, would be able to find original contractors who could perform work without the need of employing anybody to assist in it, and there is no question about it, they could. I could steer them up against them now, and that is the right way to do this tunnel work, and that is the way the railroads do their work. My figures on tunnel work assume that the laborers working in the tunnel would not be restricted to an 8-hour day. They get paid for the amount they do instead of the time they put in. That makes a lot of difference in the cost of work, too.

Hazen Witness: ALLEN HAZEN recalled for Plaintiff.

Mr. Hazen: I looked over the joint question, and I can state the result. The apparent contradiction between Mr. Dockweiler and
7434 myself evidently depends upon the definition of expansion joints. I meant the structure, and he meant the asphalt in it. It appears that the item of expense in the account for the Central Reservoir was for the asphalt, and not for the joints, and my earlier interpretation of that was wrong, and therefore, the 40 cent differential ought to be eliminated.

In my final deduction, as it appears on page 7320 of the transcript, wherein I stated as follows: "That, in my judgment, would "make a difference perhaps of $1 per yard in price; so that if we start "with $8.50, Mr. Dockweiler's figure, and add 40 cents for the expan- "sion joints, that brings us to $8.90 as the actual cost of the concrete "in the Central Reservoir. Adding $1 for the difference in finish, that brings us to $9.90, and we still have the extra expansion joints "in University Mound Reservoir concrete to account for," the 40 cents would disappear from that comparison, and it would be $9.50. You would still have the extra expansion joints in the University Mound Reservoir to account for.

7435 Witness: J. H. DOCKWEILER for Defendants.

Dockweiler

CROSS EXAMINATION BY MR. MCCUTCHEN.

My total on the Clay Street Reservoir is $16,671.68. The wrought iron tank I have at 9.4 cents a pound. The details of that are as follows:

7436

Cost of wrought iron	$ 80.00 a ton
Unloading	1.00
Freight to San Francisco from Richmond	.50
Haul, 5 miles	1.39
Fabrication	25.00
Erection, union scale, 4 cts. per lb.	80.00
Total	$187.89

or 9.4 cents. That is the figure I put it in at, and I think I have it in pretty high.

Questioned by Master.

I have the fabrication $25 a ton at a union shop. Erection at $80 is too much. That figures 9.4 cents a pound. I worked it out by the ton.

CROSS EXAMINATION BY MR. MCCUTCHEN.

The $80 is for erection at 4 cents a pound. By erection I mean
putting it in place on the ground; you can see that is a mistake. I
assumed this would be made in Richmond. The tank is 60 feet in
diameter, and 11 feet deep, and the fabricating, rolling and punching, 7437
and getting the thing in shape, would be done over in Richmond. Fabrication means to cut your plates, bend them, punch them, and bevel them, and they would be delivered in that form at the site of the tank. I have allowed 4 cents per pound for the work of putting the plates together, and doing the riveting, and that sort of thing; that is erecting all the work in connection with it. Up to the time those plates reached the site of the tank, no riveting would be done, unless there was some special work on it. Plates would come there all ready, and the men in the field would merely assemble them, and rivet them in place.

In the case of the pipe on the Peninsula, it was fabricated in
the shop in lengths; the field work would be riveting it together, and
doing the caulking. The price of fabricating the pipe in that case
would be about a cent a pound. I allow $1\frac{1}{4}$ cents here just for beveling and punching the plates, but that figure is too high. I am too
liberal on those figures. That tank in place ought to be worth about 7438
$7\frac{1}{2}$ cents a pound. It is nearer 7 than $7\frac{1}{2}$. That would give you
about 2 cents for the erection and handling it on the job for a tank
of that size, and that would be a Union scale. That allows you 4 cents
a pound for the iron. Other elements that go to make up that 7 cents
are unloading, freight to San Francisco, haul of 5 miles, fabrication,
and erection in the field. On the new schedule I would give them 2
cents a pound for erection in the field. Those tanks were erected in
a manner different from the ordinary tank, and I am figuring on
erecting them in the way they were erected, and that is this: First,
there is a slab of concrete placed, termed the foundation; the tank
then is built on skids or jacks a couple of feet above the ground,
and the whole bottom of the tank is riveted up in place. Then it is
gradually lowered, all the men working at one time, and just before
they get down pretty close, but so that the men can work on this
foundation, a very rich cement mortar is put over the entire bottom; 7439
previous to that time holes have been bored into the bottom of the
tank at various places, and this tank is then gradually lowered into
this rich grout, and afterwards through these holes grout is shot in

so as to give a uniform bearing for the entire tank. That adds very greatly to the cost of putting one of those in place; the tank is made and lowered on to this soft bed of concrete. It is a very costly operation. That is the way Mr. Schussler described to me that he built the Presidio Heights tank, and I am satisfied that that is the way he built the others. I have not given it any consideration as to whether that is the way to build it, other than that I used the method he employed. That is the most costly way of building such a tank. A less expensive way would be just putting it up on skids, as it were, and pulling one out, and dropping the whole thing on to the bottom. I think that would have a tendency to strain your bottom plates.

7440 The wrought iron pipe on the Peninsula is simpler work than erecting this tank; these tank plates are very long and cumbersome sheets of metal, while the pipe sheets are not as long, and the pipes are put together in the shop where they have every facility. My figure on pipe delivered at the trench, undipped, per pound is from 5.01 up to 5.55 cents, as indicated in "Exhibit 100". In this particular instance, the incidental work in placing that tank on the foundation is what I have allowed as the difference between the cost of fabricating and laying pipe, aside from the cost of trenching and backfill, and the making of such a tank as this Clay Street tank.

7441 Witness: ALLEN HAZEN recalled for Plaintiff.

Hazen

DIRECT EXAMINATION BY MR. GREENE.

The cost would be about the same for laying riveted pipe of the same thickness of plate in the Peninsula, and of using the same grade of iron of the same thickness of plate in the construction of the Clay Street tank. It may not be exactly the same, but there would not be a very wide difference.

Mr. Dockweiler: It would be necessary to construct false work in erecting a tank, and that cost would be included in my unit price. That comes in in the erection.

Mr. Hazen: Frequently the erection is made by building a float, and then pumping water into the tank as the work proceeds, and all the work is done from the same float, and no false work is necessary. In the case of the Clay Street tank, it is so low that I think all of it could be done from the ground, or nearly all of it. The top plates, to get them on, would take a little form work. The riveters could stand on horses.

7442 Mr. Dockweiler: I have seen them erect oil tanks, which are erected much cheaper than this tank, and they had to have some sort of staging or platform for the riveters to stand on.

Witness: GEO. WILHELM recalled for Plaintiff. 7443

DIRECT EXAMINATION BY MR. GREENE. Wilhel

I have read the transcript of Mr. Hazen's testimony, wherein he made certain statements in regard to the costs of the Central Reservoir, and I have examined his statements, and they are correct as he made them. I examined the statement with reference to the yardage, and not with regard to the cost, and those statements are correct.

CROSS EXAMINATION BY MR. SEARLS.

Those yardages were determined by cross-sectioning, which was done on the first of every month during the progress of the work; after we had completed our last cross-sections, the trimming of slopes, roadways and so forth were completed, and 11,000 yards as a rough estimate of the yardage was added for that work. I gave Mr. Hazen the segregation as between the material which was rolled and compacted, and that which was not. Those segregations were made over 7444
Saturday and Sunday last, February 19th and 20th, and were taken from the cross-sections. The computations were made by the same engineer who made the cross-sections, Mr. Ogden. The 11,000 yards finish resembled the trimming that was done on the face of the dam and the sides, and trimming the roadways around the reservoir, and that sort of work. Trimming the roadways would not appear in road work; it was simply estimated as 11,000 yards, the work of cleaning up, trimming the dam, slopes, etc. That was purely an estimate, and the rest is taken from the cross-sections.

Questioned by Mr. Dockweiler:

The steam shovel work was the work that went into the compacted dam, the dam at the Hopkins Street end, and the main dam at the lower end, all of that went into these compacted cross-section
dams. The error is not all in the other work; the yardage upon which 7445
those unit prices were based was purely upon the engineer's monthly estimate of yardage. His total estimate of yardage amounted to 225,868 yards. Then to that was added the 11,000 yards, making a total of 236,860 yards. Now, from the cross-sections that were made the total cut of cross-sections was 213,760, and adding to that the 11,000 yards of trimming, you would have a total of 224,760 as against 236,860 the other way. Then the total fill by cross-sections amounted to 217,180, and adding to that your 11,000 yards for trimming, you would have a total of 228,180, as against 236,860 yards he has estimated. That was an estimate made monthly before the cross-sectioning was done. The total yardage as estimated for steam shovel was 130,150; for scrapers 65,000; trap 14,600; graders 13,600; wheelers 13,500; making a total of 236,860. I cannot give you the same figures based on cross-sections. The cross-sections were made simply to show the cuts and fills, and were made monthly, regardless of how they

7446 were made. I would say that the same percentage of error would apply to the steam shovel work as to the other. I would say there was probably the same percentage of error.

Mr. Hazen: The fundamental point seems to be, Mr. Dockweiler, that you are assuming, in building University Mound Reservoir, that you would handle the whole of the yardage with a big steam shovel, and you would not do any finishing or trimming.

Mr. Dockweiler: Oh, yes, the trimming and finishing would come to about 1 cent a square foot over the whole basin. That is about what the Peoples Water Co. reservoir shows, which is more costly work, for
7447 the reason that we had to haul material long distances, and fill up the pits that were made by the steam shovel.

In order to get a bank for my steam shovel, I started with scrapers and excavated to a certain depth, and then I allowed 10 cents extra for material compacted in the bank; that which was not compacted, but was wasted and dumped, has the ordinary steam shovel price. I do claim that the Central Reservoir prices sustain my contention. The average haul given on the Central Reservoir material is 1500 feet. I only figured on handling such material on the University Mound Reservoir twice as was hauled in on the embankment; that would have to be compacted and rolled. I added an additional price for handling it and compacting it on the dam. You would haul
7448 that material in the dam, you shove that in with your scrapers on to your dam, then you compact it, harrow it and roll it, then your excess material, the steam shovel work, you load that into wagons, and send it to your dump—no handling at all. There is only one handling throughout. Then when you come to trim your basin, you want to allow 1 cent a square foot for that. I have here "A man will trim 1 cu. yd. per hour". I remove that with Fresnos, and it is 68 cents a cu. yd. for stripping that material. The summary is as follows: Steam shovel work, 162,242 yards at 25 cents; Fresno scraper work making the fill 24 cents; trimming your slopes 68 cents a yard; stripping 24 cents. Dividing that total yardage into the total amount brought out by the application of the different units to the classifica-
7449 tion, gives me 25.2 cents, which I rounded off to 26 cents. That is the basic price. Then you add 10 cents for the material in the dam.

The estimate for the University Mound was not based on the Central Reservoir experience, but the Central Reservoir experience carries out, in my opinion, the reasonableness of the figures which I have applied to the University Mound, because University Mound is more compact, it is more of a rectangle, while the Central Reservoir is a long, drawn out reservoir, and is a basin built on two sides of a natural ravine, which was formed and trimmed to a pre-determined slope. The same to an extent was the case of the University Mound Reservoir, but with this distinction, that the material was not shoved here and there in the basin itself to fill up the inequalities, but was

merely the trimming off of a hill which had been excavated in the 7450
creation of the reservoir—in my mind a very substantial and radical difference. The two reservoirs are comparable to the extent of showing what material can be handled for. In other words, it shows that material in the Central Reservoir can be transported 1300 or 1500 feet by steam shovel, and compacted in the dam for 40 cents a yard. You could not build the whole reservoir at that rate, but if I were using scrapers here for the haul, and using the various equipment that was used on the Central Reservoir, then I would have to vary my price, but I am not using that equipment, as there was not the necessity for using it. It just goes to determine the reasonableness of steam shovel work, and I cited it as to the cost of steam shovel work. I was on the job very often and noted it, and it is a very good piece of work. The clay was moist enough so that you did not have to have a man on the dam to wet it to any extent. They had a whole raft of men on the dam breaking the lumps. It was being spread out with a Mormon spreader, and a heavy roller was put on and rolled it most carefully; it was a very compact dam.

Mr. Hazen: It seems to me that if this data has any use at all in measuring the cost of reproducing the University Mound Reservoir, it has to be taken as it is in its entirety, and every element of cost that was involved in doing the Central Reservoir work must be brought into calculation; when that is done, and when it is applied as accurately as I can apply it, with Mr. Wilhelm's help explaining the conditions over there, it produces a cost which is greater than I have estimated for the University Mound Reservoir. Now, to go through the record and pick out the items that are cheap, and forget
the rest of them, I think that is an unfair procedure. 7451

Mr. Dockweiler: I thought it was very fair, because I am using it simply to show the cost of moving material by the steam shovel.

——————— 7452

Witness: Allen Hazen, for Plaintiff. Hazen

DIRECT EXAMINATION BY MR. GREENE.

(A sheet was introduced and added to Mr. Hazen's wrought iron schedule, "Exhibit 98". It was marked "98mm", so that it will come in consecutively in the 98 series of exhibits.)

"Exhibit 98mm" shows the basis of this calculation. The prices 7453
in the column headed "base cost" are the prices which are used as the costs of reproducing the country lines, including ordinary excavation and obstacles, ordinary appurtenances in the main part of my estimate; they are also shown on "Exhibit 98i", with this exception, that there are a few discrepancies, in no case more than 10 cents, which grew out of the fact that I made up my estimate in the schedule rule computations as I went ahead, and all these figures

were afterwards checked up by an assistant, and some slight variations were found, and these sheets have been corrected. That leaves a little irregularity in some of the differences, which I have not attempted to correct.

I took these figures in this column as representing the whole cost of any riveted pipe in District No. 3 in sand and soft clay, including all of its appurtenances, and including the lead joints. About half
7454 the riveted pipe in the city is laid with lead joints instead of riveted joints that I used outside. These lead joints add a considerable item of expense, but they are more convenient to make, and they take the place of a considerable amount of manufacturing cost, which would be represented by the bends that would be necessary to get by the obstacles in the city streets, and so I am disposed to think that taking it all in all there may not be very much difference for city work in the cost between the lead joints and the riveted joints. I did not go into that detail, and I made no further allowances for the extra cost of any of the lead joints.

In District No. 3, I did make an addition of 55 cents per foot on 22-inch pipe through hard clay and soft rock, and 90 cents for 37½-inch, and \$1.10 for 44-inch. The basis for those additions was all worked out in connection with the cast-iron pipe schedule agreed to. The extra cost of laying the cast-iron pipe of various sizes was estimated for these conditions, and when it came to the riveted pipe schedule, I simply made an addition to that corresponding to the addition which I had worked out for the cast-iron pipe.

For the No. 2 District, and the No. 1 District, representing congested conditions, and special obstacles, I followed a similar course. The cost of laying cast-iron pipe in those districts had been estimated, and had been worked out before this estimate was made in a schedule which is in the case. In the case of the riveted pipe, I simply made the assumption, which I believe to be as fair an assumption as can be made, that the added cost of laying the pipe in District No. 2, and
7455 in District No. 1, over the base cost in District No. 3, would be about the same as it was for cast-iron pipe, and so I subtracted the estimate for the cast-iron pipe for those districts, taking No. 3 from No. 2 and No. 1, and then with those differences, I determined the additions to be made for riveted pipe. I subtracted my figures on the cast-iron from the agreed figures, but of course the agreed figures did not exist then. In the case of the larger pipe, which were larger than any of the cast-iron pipe, I did not go into any further analysis, but used figures that were a little larger, and taken approximately in proportion to the added diameter. These additions were made. This table shows how those totals were carried out. They were multiplied by the length in the schedule. I think that covers everything, except that there was a little special price at the Bernal Tunnel, and on a trestle near it, which apparently represented considerable additional expense.

There were some special joints there, and there was a somewhat arbitrary addition of, I think, $2 or $3 a foot made there. The 30-inch on trestle seems to have been estimated at the same price as if it had been buried in the earth. The $15 a foot on the 44-inch represents what I was just speaking of. That is, the base price was $1.90, and I seem to have added $3.10, making $15 for the extra work at those sections.

The cost of laying pipe is greater in the central part of cities 7456
than it is outside; it is frequently very much greater. The basis for estimating the excess cost is one of the hardest things that has to be handled in the waterworks business. Frequently it happens that when a plant is being valued, some lines have been laid in downtown districts within recent years that give some clue to the added cost that 7457
is involved. In the Spring Valley system there is no data of that kind that gives an adequate basis for estimating the cost of pipe in the downtown region. The City has built a high-pressure fire system in recent years, and the cost of that work throws some light on the local conditions. I had those costs before I made this estimate, and considered them, but the figures that I estimated were very much lower; in fact, hardly approached them.

At Springfield, Mass., where we designed a whole new distribution system for the city, utilizing the old pipe, but laying out the whole system, estimates were made in my office of the cost of doing the work, and base prices were used for the work in the outlying districts, and additions were then made to the estimate for extra cost of laying pipe in streets where traffic was heavy, and where there were obstacles underground. When the work was built for all the outlying part of the system, it was built for figures pretty close to our estimates, but in the central part of the city the costs over-ran. Perhaps not in every case, but in the aggregate they over-ran very much; in other words, we had not estimated enough.

I also got some costs in Seattle, where a pipe was laid through Second Avenue for quite a distance. That was last year, or possibly the year before, and I had those figures from Mr. Dimmick, the City Engineer. Also the figures for laying pipe in the outlying districts, showing a very marked increase over the cost of laying pipe in the city. I had other data of that kind in connection with almost every plant where there are substantial city conditions that I have had to do with in this way. In view of all those conditions, my estimate for cast-iron pipe was based upon the idea that the labor costs of laying pipe, including excavation and placing, and making the joints, in the 7458
No. 1 District would be double what it was in the No. 3 District, and that the No. 2 District would be just half way between. In connection therewith there would be some increase in the bill of materials, because some specials have to be used, and more joints and more lead is required. I also have the records of certain riveted pipes laid in

Brooklyn in the outskirts of New York City, done for the Board of Water Supply, with which I am connected, but I did not have to do with laying these particular pipes, and which show very great increase in the cost of the pipe as the city was entered as compared with the outlying parts of the same line. I do not think that data is directly applicable, but data of that kind was available to me, and influenced my judgment in making the estimates I did for the added costs in this case.

The exact number of obstructions that would have to be encountered can never be determined in advance. As the trench is opened, the streets are full of underground obstacles that have to be handled in some way. In laying a large pipe, many of the smaller things have to be moved, and that means that arrangements have
7459 to be made with the owners of the things, otherwise, the water pipe has to go by them. The interference is greater, relatively, in a city like San Francisco than it is in some other places, because the water pipes are normally laid near the surface here, and gas pipes and telephone conduits, and everything else, are laid at such levels that there is a constant interference. In New York, or Chicago, or in Boston, on the other hand, where the water pipes are laid at a much greater depth because of frost, they ordinarily go under most of those things, and there is not so much interference. The cost is increased by the fact that materials cannot be piled up in the street, that guard rails have to be put around, and watchmen kept on the work; it has to be lighted at night; wherever streets are crossed, the passages have to be kept open for traffic, which frequently means temporary bridges, and bridges entering any property that there is along the line. I think the fact that work in the city is more expensive than work outside is obvious to anyone who gives even a most casual inspection to work that is going on in Market Street. The basis of the estimate is a very difficult matter to get at. The basis that I used, in my judgment, is a perfectly fair one for this purpose. If it came to making an estimate on which the pipes were to be laid for a client, I would want to raise it, because I think in all probability it would cost more to lay the pipe in the downtown section than my estimate calls for.

7460 The banks of the trenches would be more likely to cave in the city, but I should not attach much significence to that. When they do cave, it involves a great deal more expense.

Questioned by Mr. Searls.

This does not include the paving. That is all in my schedule, but estimated separately. The actual cost of the city high-service pipe system, which I had and analyzed, would support a considerably higher figure than I have used, but there were various matters in connection with that, and I did not think it was perhaps best to use a figure as high as it indicated, although I do not feel at all sure

that the work could be done on a lower basis if it were actually to be done now.

Questioned by Mr. Greene.

COMPARISON WITH CITY HIGH SERVICE FIRE PRESSURE SYSTEM. 7461

In comparison with this, the actual experience of a city in laying the pipe for the high service fire pressure system is particularly instructive. (Refer to F-3). Eight contracts for laying this pipe were made. Three of the contractors failed, and the work was readvertised. It is obvious that this work turned out to be much more expensive than was anticipated, and the contractors who secured the first contract were unable to succeed with them. Disregarding the prices in these three contracts, and using the average for the other five, the average cost of excavation was $1.23 per cubic yard. For an 8-inch pipe in the distributing system, the average excavation per foot is 0.26 cu. yd. At this price the cost per foot is 32 cents. The average contract price for hauling and laying 8-inch pipe was 57 cents per foot. Adding the two makes the average cost of laying 89 cents per foot. This includes the hauling, which in our schedule is estimated separately. Assuming that the high service pipe is 50% heavier than the pipe in the distribution system, the cost of hauling it at $1.50 per ton, the base price used in the estimate, amounts to 5 cents per foot. Deducting this, the approximate average price of successful contractors for laying 8-inch pipe, for comparison, was 84 cents.

In a general way, about one-half of the high service work was in the first district, and one-half in the second district. The estimate used for laying 8-inch pipe in District No. 1 is 55 cents per foot, and in District No. 2, 41 cents per foot. For a pipe, half in each, the average would be 48 cents per foot. In comparison with this, the average contract price for the high service system was 84 cents per foot.

The price now estimated is only 55% of that actually paid in the city work.

It must be remembered, in this connection, that the city pipe is heavier, and tested to a much greater pressure. Some of it had double joints, but this does not enter into the comparison, because 7462
an extra price was paid for these, and this has not been included in the above statement.

Making all possible allowance for difference in the character of the work, it is apparent that the price paid by the city for this work was considerably above that now estimated. Similar comparisons could be made for other sizes of pipe. Eight inch is selected because it is the predominating size in the Spring Valley system.

Comparisons for other sizes have been made, and are shown on

tabular statements, but the statement is easier to follow when presented for one size at a time only.

COMPARISON OF AMOUNT ESTIMATED FOR PIPE LAYING FOR SPRING VALLEY SYSTEM, WITH ACTUAL COST TO CITY OF LAYING HIGH SERVICE PIPES UNDER CONTRACT.

7463

Size of pipe	6″	8″	10″	12″	16″	20″
Average Cost High Service System Under Successful Contracts:						
Average price per foot for excavation	$0.28	$0.32	$0.36	$0.41	$0.56	$0.70
Average price per foot for hauling and laying	0.63	0.57	0.60	0.68	0.82	0.86
Sum	$0.91	$0.89	$0.96	$1.09	$1.38	$1.56
Deduct cost for hauling	0.04	0.05	0.08	0.10	0.16	0.23
Approximate average contract price for laying	$0.87	$0.84	$0.88	$0.99	$1.22	$1.33
Our estimate for labor						
District No. 1	0.46	0.54	0.66	0.76	1.06	1.40
District No. 2	0.34	0.40	0.50	0.57	0.80	1.05
Average for the two districts	0.40	0.47	0.58	0.67	0.93	1.22
Percentage which our labor cost is of the city's actual cost for high service system	46	55	66	68	77	92

7464 I did not attempt to reduce those elements to cents per foot; it is obvious that the comparison is not one that can be directly made. On the other hand, the main problems of laying the pipe in the high pressure system were exactly the same as those that would be involved in laying the pipe in the Spring Valley system. The fact that the pipe was tested to a higher pressure involved extra care in making the joints. I don't know that there would be any extra cost involved in leaving the trenches open, etc., as they did in the high pressure system, because that is customary in laying water pipes. I should not expect that they would be more likely to have trench blowouts, with good designing; I should think they would happen with one pipe just as much as with the other. If the design
7465 is equally good, those unbalanced pressures would be taken care of by some kind of bracing. I don't see any reason why they should be more likely to happen on the high pressure than on the low pressure. They happen on all work at times. We had several blowouts in the Springfield system which carried pressures equal to those carried in the Spring Valley system; the bracing is intended to be adequate, but there were many places to be braced in that case, and through some ones carelessness or negligence the bracing at one point is not sufficient, and it gives way, and it makes a big hole and a cave-in, and a good many thousand dollars damage can be done in five minutes.

7465½ I think it is harder to get directly applicable data here, perhaps more than in any of the other structural features, because, for

instance, this job in Seattle, as to which I got the costs, I found out how much more that cost approximately than country work, but to say that Second Avenue in Seattle is comparable to Market Street, or to any other street in San Francisco, would be open to objection; it is a matter of judgment. All I know is that certainly where there are city conditions, the cost of the work goes up rapidly with the density of traffic that it has to meet. I have this estimate, which I believe is a fair one under the circumstances. In view of all my experience I believe it is less than any one could hope really to build the work for.

On the Sunol water temple I was furnished with a record of 7466
cost, and I audited that and took out the overhead, which included the architect's fees, and engineering, and I also took out, as nearly as I could get it, that part of the whole cost which was represented in concrete in the sub-structures put in by the cubic yard. The cost of the temple, as I had it from the financial department, seems to include some concrete in the foundation, which was otherwise in the schedule. To the best of my ability I tried to audit it so that nothing was in twice. It was a hard matter to get at exactly, because so often the schedule is divided on certain lines, and the costs of construction relate to work separated on somewhat different lines. It is a very common occurrence in this kind of business.

The masonry aqueduct is a very old structure. I think that 7467
was built long before the Spring Valley's time, and was acquired by it in connection with some water rights property. The squared stone masonry is estimated at $12, and the brick masonry at $25, probably less than they could be reproduced for as they are, but producing a sum sufficient to build a concrete aqueduct of modern design, and for equivalent service.

The flumes were estimated the same as the other flumes; the wrought iron pipe conduit, given on page 80, is in my riveted pipe schedule. The steel bridge is mostly marked off in depreciation. These other smaller items I do not think require any discussion. As to any items in my inventory which I do not specifically cover, they represent my best judgment of what the several things were worth at the time. In regard to many of these very small items, I did not look at them with the same attention as I did to the main structures. This Niles Aqueduct forms no part of the Spring Valley works, but it is necessary to operate it to carry out and fulfill certain obligations in connection with the water right.

In arriving at the stock on hand, I was furnished with detailed
inventories, which I have not with me right now. I looked through 7468
those, and I also looked over the stock, and formed my judgment as to its conditions and probable value. Much of that stock was bought in years gone by at higher prices than are current, and it was carried in the inventories at cost to the company. I applied

some discounts to that, that in my judgment approximately cut off the surplus amount, and brought it to about the present fair market value. I did not go into that in very much detail, because inventories always have to be adjusted in the case of a sale. That was what I was looking to at the time.

7469 That inventory is part of my estimated cost of reproduction. The inventory seems large to the Spring Valley business, but that is in part due to some materials that were bought to build some structures that were not built. Aside from that, though, it seems necessary to carry a much larger stock of miscellaneous materials, at a place so remote from the points of manufacture, than is the case in Eastern cities; it takes so long to get material here to meet all breaks that come up suddenly, and it is necessary to carry that stock in the storehouses. That means a great deal larger stock account than I should expect to find in an Eastern city of the same size. I think the amount I carried is in my estimated cost of reproduction of the plant.

Mr. Metcalf: It is my recollection that our estimates of the net value of that stock were less than the estimates of the city engineers.

7470 Questioned by Master.

Mr. Hazen: Referring to "Exhibit 97"; the item, miscellaneous planting, means this forestration that has been done. I don't know whether that is carried in capital account, or not. It includes a good deal of shrubbery around the pumping stations and reservoirs; at Sunol there is a nursery, and at Merced there is a nursery.

Mr. Dockweiler: On page 250 I have stock on hand for the
7471 outside properties, \$178,694.88, and for the city distributing system, \$139,700; total stock on hand, \$318,394.88. I didn't depreciate it. Mine is just what the inventory of the company showed, and I didn't make any depreciation, as I thought that until it is used, it does not depreciate.

Elliott

Witness: G. A. ELLIOTT recalled for Plaintiff.

7472

DIRECT EXAMINATION BY MR. GREENE.

All of the wrought iron pipe that has been put in since 1909 in this city has been put in by me. I have seen considerable of the pipe that has been laid before I was connected with the company. The 36-inch wrought iron pipe, laid with lead joints, on Bryant Street, between Eleventh and Seventeenth, had a total length of 3,354 feet. It was laid about two or three years ago, and the total labor cost was \$10,765; teams, \$1,212.24. The following table explains it:

FIELD COST OF LAYING RIVETED PIPE. 7473

Location	Joints	District	Length	Labor	Teams
Bryant St	Lead	1	2887'—36" x 3/16" 335'—36" x 1/4" 132'—36" x 5/16"	$10,765.36	$1,212.24
			3354'—36"		
Per foot				$3.21	$0.305
Sloat Blvd.	Lead	3	4325'—30" x 5/16" 939'—30" x 1/4"	$5,701.96	$510.62
			5264'—30"		
Per foot				$1.08	$0.098
Santa Clara Ave.	Lead	3	3846'—30" x 1/4"	$4,706.40	$628.93
Per foot				$1.225	$0.164
Golden Gate Park	Rivtd.	3	3202'—30" x 1/4"	$6,719.00	$610.00
Per foot				$2.10	$0.19
Central Pump Supply	Slip	3	8248'—30" #10	$4,147.66	403.00
Per foot				$0.50	$0.049

Central Pump Supply Main, is a light pipe with slip joints, laid in a shallow trench on the Merced Ranch. Only the lower quarter of the backfill was tamped, and the remainder of the fill, including what is ordinarily termed "Surplus Excavated Material" was shoveled into the trench.

A slip joint is made by inserting the small course of one length of pipe into a large course of the adjacent piece, heating the connection, and ramming the two pieces together. This joint is used on low-pressure, and depends for its tightness on the asphalt coating.

Questioned by Master. 7474

These are not units of finished work at all. This is just the field cost. The Bryant Street was located in what we have termed District No. 1, which is a district where most of the difficulties are encountered. It was laid with lead joints.

DIRECT EXAMINATION BY MR. GREENE.

The next item is the pipe laid on Sloat Boulevard, known as the Central Pump Force Main. That was a riveted pipe, laid with lead joints, about a mile long. It is located in District No. 3, which corresponds somewhat to out of town, or country work.

The next item is Santa Clara Avenue, which was a riveted pipe with lead joints. That is laid through Westgate Park to replace the flume that used to run through there. That is also in District No. 3.

The next item is the Golden Gate Park Main, which was laid last September, or October; that is a riveted joint line.

The next item is the Central Pump Supply Main. That was a slip joint pipe, made partly of new steel, and partly of old pipe we had on hand. It was very thin. There were three or four lead joints used in the whole 8,000 feet. The remainder of the joints were made simply by slipping the pipes together, and depending on the asphalt coating for tightness. That was laid on the Merced Ranch, and in a very shallow ditch; the backfill was tamped only up about a quarter of the distance from the bottom of the trench, and the remainder of the material was loosely shoveled in and left there for the rains to settle it; in other words, it was not laid in a city street.

7475 In general, I might say that those pipes were laid during a period of hard times with the Spring Valley Water Co., and sometimes it was pretty difficult for me to keep within my estimated allowance. We had to use, in a great many places, cheaper methods than Mr. Schussler had used. Fortunately, for the most part, the pipes in question here were pipes that had been taken up in other parts of the works, so that the material that went into them was very good. These costs are not completed costs that I have given you, at all.

Mr. Hazen: I estimated $5 a ton, a quarter of a cent a pound for freight and teaming; that would include the freight where it went partly by rail, as would be the case of most of the pipe, except those in the city. That would not furnish a direct comparison with what Mr. Elliott is giving here.

Mr. Elliott: The plates that were used in this recent job in the park, were bought sometime before the earthquake. They were originally intended for a force main from the city pump on the Merced Ranch. Due to financial stringency at the time of the earthquake, the pipe was not made up, and the plates were afterwards shipped to Millbrae. Last October, when it was decided to lay a pipe across Golden Gate Park, those plates were shipped to South
7476 San Francisco, to the Schaw-Batcher Works, and made up into pipe. They are steel plates.

I have some photographs here that show the Bryant Street pipe work two or three years ago. They are intended to show the proximity of the car tracks, the character of excavation, and in general the method of laying the pipe. This pipe was laid in 1912, I think. The upper picture shows the character of excavation, and the pipe in place on Bryant Street; the lower picture shows the trench in the vicinity of the crossing at Sixteenth Street, illustrating the board walk you have to put across the trench; the car track crosses there also.

The next one shows the same view from the opposite direction,

showing a car coming up alongside the trench; the lower picture, on page 2, shows the pipe along side the sidewalk.

On page 3 the upper picture shows a car stopped along side the trench in the vicinity of Sixteenth Street; the lower picture shows the character of part of the excavation; that is what I classify as rock excavation. 7477

Page 4 is simply a general view of the work; the lower picture shows the rock in the side of the ditch.

The upper picture, on page 5, is a general view of the ditch on Bryant Street; the lower picture had to do with the work in the park, and shows the men punching the holes in the pipe in order to rivet on the man-hole.

The upper picture, on page 6, is the man-hole in place; the lower picture shows part of the work of putting on a strap to form a bend.

The upper picture, on page 7, shows the strap riveted up in place; the lower picture shows a nozzle of an air valve.

Photographs showing pipe laying introduced and marked "Plaintiff's Exhibit 147".

ONE HUNDRED AND THIRD HEARING. FEBRUARY 24, 1916.

Witnesses: J. H. Dockweiler for Defendants.
G. A. Elliott for Plaintiff.
Geo. L. Dillman for Defendants.
Allen Hazen for Plaintiff.

(Mr. Hazen's office schedule of October 30, 1912, as to the cost of steel pipe, was introduced and given the number "Exhibit 98jj"). 7478

Witness: J. H. Dockweiler for Defendants. Dockweiler

CROSS EXAMINATION BY MR. McCUTCHEN. 7479

I do not recollect in testifying with reference to the excavation at Pilarcitos that I stated that I would use a steam shovel with a dipper capacity of 1¼ yards. I do not remember whether Mr. Mullholland used a 1¼ yard bucket on the Franklin Canyon work, or not. In suggesting the yardage which I could move with that machine in a 1¼ yard dipper, I had in mind the experience of Central Reservoir, because I knew the handicap under which that machine worked with Central Reservoir in moist clay. I think the material at Central Reservoir was good. It was a 2½ yard dipper that was used at Central 7480
Reservoir. In determining the cost of the work at Pilarcitos with the 1½ yard dipper, I had the Central Reservoir experience, but in addition to that I had the record of what Mr. Mulholland had used with a

¼ yard smaller sized dipper. Working on good, big banks, such as they would have at Pilarcitos, it was my estimate, as given on page 5038 of the transcript, that the steam shovel in 9 hours, with a 1½ yard bucket, would enable me to put in 900 yards per day. At Pilarcitos you don't move your shovel much. The experience with the 2½ yard dipper on the shovel used at Central Reservoir could not necessarily be used for the purpose of determining the cost of moving the material at Pilarcitos with a 1½ yard dipper. I gave it weight,
7481 but I also cited Mulholland's output, and as a result of all the information I had, that was the figure I determined on at Pilarcitos.

I think the work at Pilarcitos can be compared with the work at Central Reservoir. The Pilarcitos work can be done cheaper, because you have that big bank where your shovel will be all the time. The experience with the shovel with a 2½ yard dipper at Central Reservoir cannot be used as a direct comparison for the purpose of determining the expense of excavation at Pilarcitos with a 1½ yard dipper, but I would do this; I would say, if my 1½ doesn't give me the output, why not use the 2½? I would not then have a bigger crew than I allowed for at Pilarcitos.

I do not think that the Central Reservoir work can be used fairly and legitimately, taking into consideration the conditions under which it was done, for the purpose of determining the cost of steam shovel work at Pilarcitos, using in the Pilarcitos case a steam shovel with a 1½ dipper, whereas, there was used at Central Reservoir a steam shovel with a 2½ yard dipper, but I will then change my estimate,
7482 and state that I will use a 2½ yard shovel.

Questioned by Mr. Searls.

If you use a 2½ yard shovel, and make adjustments such as Mr. Hazen made with respect to the other costs over there, you certainly can have a figure that will have some bearing on the cost of doing the work at Pilarcitos. In order to say that the Central Reservoir work was more or less comparable with Pilarcitos, you would just simply substitute for the 1½ yard machine the 2½ yard machine. You would not have to make any other adjustments on your payroll on the cost of getting the machine in there in order to make it comparable. I think the estimate is sufficiently parallel to cover it. Well, assume that it would cost you at the utmost a cent a day more; that is about all the change I would make in it.

7483

CROSS EXAMINATION BY MR. McCUTCHEN.

By that cent a day more, I mean for the additional cost of the machine, and the cost of operation. Assuming that you moved 900 yards a day, I estimate that the daily expense would not be more than $9 over the smaller machine, and I base my statement on that because I know the operating cost of machines at Central Reservoir, despite the fact that they paid $30 a day for the machine; I knew the crew

that was there. A machine with a 5-yard dipper would cost more, but you couldn't use a 5-yard dipper, for the reason that your wagons would not hold it. It would cost more to operate it. It is my opinion that adding one cent to the cost would cover the difference between the 2½ yard dipper cost as compared with the 1½ yard dipper. That is based on the fact that I know the operating cost of that shovel over there. I don't recollect whether I used those in determining operating cost of my shovel here. I have given you the same crew at Pilarcitos, the same number of men, that operated the shovel at Central Reservoir.

Witness: G. A. Elliott recalled for Plaintiff. Elliott

DIRECT EXAMINATION BY MR. GREENE. 7484

Referring to the pipe in Golden Gate Park; I have that total cost developed here in connection with my fundamental data on which the estimate is based, and you will find that on pages 9 and 10. The total cost of the work, \$23,536.10 is shown on these two pages. The first page gives the materials, and the second page the labor and the teaming. This total cost is within about two-tenths of 1% of the cost shown on our auditor's books. The total per foot is \$7.25, which is roughly 7¼ cents per lb. on the weight I have used for the 30-inch and the 36-inch pipe.

I have made an appraisal as of 1913 of the large wrought iron pipe in the city distribution system, and that is the schedule that you are handing me.

Mr. Elliott's appraisal large wrought iron pipe in city distribution system introduced and marked "Plaintiff's Exhibit 148".

Mr. Elliott's basis for determining gross reproduction cost of large wrought iron pipe in the city's distribution system introduced and marked "Plaintiff's Exhibit 149".

My experience in laying riveted wrought iron pipe, or steel pipe, 7485
has been confined particularly to the work that is done on that pipe in laying it after the pipe has been received. I have no particular knowledge of the cost of fabrication, in as much as the company has not purchased any pipe of that sort, with the exception of the park job, since I have been with them. I have had to assume a somewhat arbitrary basis of the cost and weight of finished pipe in San Francisco, in order to apply my figures for placing it in the streets.

In making up the estimate of handling the pipe after receiving it and putting it in the trench, I have done this more or less in detail because the figures were available. In the small schedule, just handed in, I commenced the operation of handling this pipe with hauling; the table there shows that I have instanced four jobs, and show weights, miles, and ton-miles, and the actual cost of doing that work,

7486 and the cost per ton-mile. This schedule of work is very similar to that that is used in laying cast-iron pipe, and I, of course, have had a considerable number of cast-iron pipe instances as well.

In the hauling of riveted pipe it costs more than cast-iron pipe, because greater care must be taken not to injure the coating of the pipe, and then due to the dimensions of the pipe as compared with the weight, it is not as compact as cast-iron, and very often you cannot take a full load on the wagon. It is also more difficult to handle riveted pipe in loading and unloading, due to the extra care that must be taken not to injure the coating. That also applies to handling the pipe after it is unloaded from the car into the trench. From these hauling costs, and also the cost of handling cast-iron pipe with teams and motor trucks, I derived a cost of $1.25 per ton-mile, and I have assumed for all of my pipe work that the average haul in San Francisco would be 2½ miles, which makes it $3.12½ per ton for handling the pipe from the railroad cars to the street where it is to be laid, including unloading from the cars, and unloading from the wagon in the street.

The next item is laying: By laying I mean moving the pipe from the side of the road and into the trench, entering the ends, and getting them ready to make lead joints. On San Jose Avenue, laying the 22-inch pipe, weighing, according to my arbitrary weights, 59 lbs. per foot, the cost was $4.40 per ton.

On Bryant Street, the 36-inch pipe cost $5.08 per ton. In Golden Gate Park the 30-inch pipe cost $7.20 per ton. I have used on an average, for the entire city system, $5 per ton, which amounts to ¼
7487 cent per pound. The first page in the small schedule, under the heading of "laying", gives the unit I have used, and also the cents per foot for each of the sizes shown in the city schedule.

The next operation in the laying of this pipe was making the joints, and that includes caulking the joint after it is made, and making the lead joint. This cost cannot be determined on a poundage basis for all sizes of pipe, because it is more a function of the circumference or the diameter of the pipe; in addition to considerable data, I have knowledge of the cost of this work in cast-iron pipe, and some specific cases of wrought iron pipe. On the Bryant Street job 142 lead joints, 36 inches in diameter, cost $6.10 per joint, or 32.2 cents per foot of joint caulked. On the San Jose Avenue job, the caulking, lead, and clay, labor, cost 26.6 cents per foot of joint cost. The cost of making lead joints on riveted pipe is necessarily greater than on cast-iron pipe, because a band is used which covers the entire joint. It has to be set, and there is twice as much clay labor on it as there is on a cast-iron pipe, where you have only one side of the joint to handle. For this operation I have used 28 cents per foot of single circular joint. By single circular joint, I mean this: In wrought iron pipe in every joint that is made with lead, you have to caulk

both sides of it. By single circular foot I mean one side a foot along the circumference, and to my mind that is a better unit than to take it per pound. It can be taken per pound for any given size and thickness of pipe.

The next item is the excavation of the trench, which is practically
the same for cast-iron as for wrought iron, so that I have the same 7488
data for both. The table given in the schedule shows the width and depth of the trenches that were used, and the excavation in cubic yards. The volume of pipe in cubic yards, which has been assumed as the amount of material that has to be wasted. In other words, it could not be backfilled into the trench in sand excavation. The sand excavation is shown in this schedule. There was considerable data available, both for older work, and in the later work of last year, about 12 miles of pipe were laid, which were used as a check on the earlier figures. Using these data I arrived at a cost of 40 cents per cubic yard for excavating in sand and sandy clay; what is known as easy digging. The reason that I took sand and sandy clay as the same material is that the cost is very nearly the same, and the amount of these two materials very nearly balances up. Sand, possibly, without cribbing, can be handled for a little less than 40 cents, whereas the sandy clay runs somewhat over 40 cents. Forty cents seemed to be a fair average figure. For hard clay, and soft rock, which I have defined as a clay or shale rock which will require the use of a pick to break it down, and which will stand in the trench without shearing off after exposure to the weather. We had a company record of somewhat over 4,000 yards which cost 81.4 per cubic yard; a few small jobs gave a cost as high as $1.20 a cubic yard. I have used 85 cents per cubic yard for this class of excavation.

The next classification is hard rock, which is not very extensive
in San Francisco. We have never encountered any considerable 7489
stretches of it since I have been in San Francisco. We have met with pieces 200 or 300 feet long. On Bryant Street, for instance, some of that excavation in rock went as high as $11 and $12 a cubic yard. We do not use powder in that work, because there are so many other underground structures that we might injure them, and then it is a considerable operation, in point of time, to get a permit from the authorities to use powder. It is cheaper to go through it without it. On pipes of 16 inches diameter, and over, I have allowed a differential of a certain amount per cubic yard, due to the fact that the material has to be handled twice on the edge of the trench. The men in the trench shove it up to the edge, and it accumulates so rapidly, and obstructs so much space there, that they have to move it over to one side; for that cost in pipes of 20 inches and over, in sand and sandy clay, I allowed 5 cents a yard, making it 45 cents. For the same size pipes in hard clay I use 95 cents a yard. We have never kept the cost of lagging, or cribbing sand trenches separately until recently, and the

consequence is that I have only one example of that, where we had a
7490 trench 3,270 feet long, which cost, for labor and material, for lagging, a little over 15 cents per lineal foot. I have not made any specific allowance for lagging trenches in sand, assuming that 40 cents would cover that.

Questioned by Master.

That is to say, in my experience, except for this, all lagging was carried under the excavation cost. I don't know what it would cost separately. For backfill we had the same records available as were available for excavation. On page 5 it is shown that sand and sandy clay costs 22 cents a cubic yard for backfill; hard clay and soft rock, 39 cents—I have used 40 cents for that—and hard rock, 50 cents. The reason for using 50 cents on the hard rock was particularly with wrought iron pipe; you cannot backfill the hard rock right in against the pipe; if there is any other material available, we always take it, so that the coating will not be injured, because the life of dipped pipe depends, practically, on good coating.

In explanation of the depth of the trenches made in my schedule, we made measurements amounting to somewhat over 1200 to ascertain the cover on the top of the pipe, and it showed a cover of 32 inches. I have used 30 inches, adding to that the outside diameter of the pipe, in order to obtain the depth of the trench in each case.

On page 6, the item of removing surplus excavated material appears. This is the material that has to be removed because its place has been taken in the original excavation by the volume of the pipe that has been laid. In many instances we have had considerable trouble, particularly in the downtown districts, finding a place to put
7491 this material. On the Bryant Street job we actually had to pay for a dumping ground. In the outlying districts we don't encounter that trouble. There are given here recent costs to get rid of the excavated surplus material, showing a cost in one case of 26 cents a cubic yard, and in another case 22 cents, in another case 29 cents, in another case 13 cents, and in still another case 67 cents per cubic yard. The 67 cents is the case where we had to pay for the privilege of a dumping ground. I have used 30 cents per cubic yard on all pipe, figuring the yardage at the volume of the pipe; the yardage is shown in the table under the heading "excavation".

Questioned by Mr. Searls.

I have multiplied my unit price by the exact displacement of the pipe.

DIRECT EXAMINATION BY MR. GREENE.

Miscellaneous items: This covers tools lost, worn out, and depreciated, and miscellaneous material such as plugs, cross bars, bell-bands, eye bolts, shears, small nipples, etc. Miscellaneous supplies, such as coal oil, flags, small bills of lumber, nails, books, lanterns, pipe

paint, tallow, sacks, and other things. Incidentals, such as car fares, telephones, fee for permit to open streets, and so on. Hospital and insurance, comprising insurance of labor against accident, and medical attention for injuries sustained by workmen. Wages of labor while unable to work through injuries received on the job. This figure is based on recent work we did in San Francisco, and amounts, as shown on page 7, to a total of $1,506. In other words, 1.8% of the labor cost was the hospital and insurance cost of the work.

The miscellaneous materials amounted to 1.65% of the value of the materials used in this work. I have used 1½% of the value of the materials. For hospital and insurance 2½% of the labor costs for 7492
laying pipe in districts in sand. All of these figures are summed up on page 11, wherein is shown a schedule in which I worked up the cost of all the wrought iron pipe laid with lead joints in San Francisco. On page 12 is given the total unit cost of each size of pipe shown in the schedule in the different districts.

In the agreement between Mr. Ransome and myself, in regard to the inventory, there was involved districting of the city into three districts wherein the difficulties of laying would be different. The district on which we based our figures was called District 3, and was supposed to represent the outlying sections. The next one was District 2, which was an intermediate district between the downtown district and the outlying portions, wherein you would find a medium amount of underground structures, a medium amount of traffic, and a medium amount of car lines. District No. 1 was the downtown district, which we called the most difficult district of all. Those districts involve a change in the material, and in the labor. Taking District No. 3, which was the easy district, and District No. 1, which was the downtown district, you will find many more underground obstructions in the streets downtown than you would in the streets in District No. 3. This would involve the use of a good many more fittings, and that, indirectly, involves the use of more lead. Then in the excavation downtown, you cannot leave it on the streets in the same shape as you can in the outlying districts. You are constantly meeting with trouble due to traffic in handling both the excavated material, and in laying the pipe.

Speaking of page 11, under the second heading, the 4th item, is 7493
the cost of the lead itself, and the other, down below where it says "28 cents per circular foot of single joint", is the labor cost of making the lead joint.

The company has a comparatively small amount of wrought iron pipe in San Francisco, but the same difficulties would be met with in laying wrought iron pipe in these various districts as are shown in laying cast-iron pipe. In fact, it would be a little more severe on wrought iron, because cast-iron is a good deal easier to handle, and you can buy bends in almost any shape you want, whereas, you have to have them

made up for wrought iron pipe. This book of photographs which I have here contains pictures that were selected from quite a number that were taken while the pipe was being laid.

Questioned by Mr. Searls.

Referring to the depth of trenches; there are 32 inches of cover over the top of the pipe, and then you have to add the outside diameter of the pipe to that. That figure was obtained from 1,233 measurements made in the streets. When we encounter obstructions, such as cross pipe, and so on, we usually make a bend and go under it. The
7494 fact that the high pressure system was laid further from the surface, I guess was a matter of choice. We simply assumed that depth, and all the pipes were laid at that depth. It may have come about that in 1850, when they started to lay pipe, there were not very many pipes under the ground. I would not say that the high pressure system was laid to a considerably greater depth than the Spring Valley pipe, and I base that on this, that in almost in every block in San Francisco, it seemed to me, in laying that high pressure system they were encountering our pipes, and they had to move them all the time.

A book of photographs showing the laying of pipe introduced
7495 and marked "Plaintiff's Exhibit 150".

Questioned by Master.

The reason we put in lead joints in the city is that in the city streets the pipe had been continually disturbed by excavation; a riveted joint line is perfectly rigid, and a lead joint line has some give to it.

Questioned by Mr. Greene.

I have laid between 50 and 60 miles of pipe of all sizes.

Questioned by Master.

I have a memorandum here of the cost of lining the Sunol Filter
7496 Gallery. It is a concrete lining, running from the Water Temple south. The specifications call for the 1-3-6 mix; there were 2,200 barrels of cement used, and approximately 2,000 yards of concrete placed. The materials were supplied by the Spring Valley Water Co., and the entire aggregate cost was 60 cents a cubic yard on the job, the reason for that being that the gravel was not hauled over 100 yards from the creek bed. The total cost on the books of the company was $19,687.82. In addition to that, however, the contractor claimed that he lost $2,029.79 on the work. The actual cost, divided by the yardage was $9.84 per cubic yard. The contractor's loss amounted to $1 per cubic yard, but he was not paid for that. The cost to the company was, and this is the field cost only, $9.84 per cubic yard. The $9.84 does not include the $1. There were several concrete jobs done there, and I suppose when the men went out and measured up for the inventory, which was based on 2,188.9 cubic yards, they sub-divided differently than when we let the contract.

Mr. Hazen: My figure that compares with these $9.84 is $10. I 7497
used $10 where I thought it comparable, but some of them were double-barreled, and otherwise more difficult, and for those I used $12.

Questioned by Mr. Searls.

Mr. Elliott: I have not made any other analysis of this figure than I have given. That involves everything we have on the record. The roof was not in any of the lining. The gallery was originally excavated, and lined with wood. It is roughly half a mile long, and it varied in depth from 10 to 20 feet. In placing the concrete, the original boards were left in place, and forms placed on the outside, and concrete placed in the lining of the sides first. The work was all from the top. It was not like lining a tunnel; it was a gravity job. When the walls were built, they placed a board across underneath, and built on the top, which was 4 inches thick. The whole thing was done simultaneously. The mixer was placed right on top; the gravel was hauled up on top of the bank and shot down to the mixer, and dropped right into the gallery itself. It was what we thought a pretty easy job. There was some reinforcement in it, and that is included in this price.

Questioned by Master.

The item "wire mesh" is detailed in the inventory ⅝ inch rods
and wire mesh. I think the inventory, in regard to the size of the 7498
steel, and so on, was made up from the specifications.

Mr. Hazen: My price does not include the reinforcing. It was estimated separately.

Mr. Elliott: My figure does include the reinforcing.

Mr. Hazen: Mr. Elliott's weights were a little greater than mine 7499
on the smaller riveted pipe, and practically the same on the larger pipe.

Mr. Elliott: I applied to that schedule, right straight through, a lead joint cost; I assumed that the entire pipe in the city system is laid with lead joints. In other words, I made no difference between the lead joints and the riveted joints in San Francisco. I didn't estimate on any riveted pipe at all. I think there is 50% riveted pipe in the system, and 50% lead joint, and it is pretty hard to say
which cost the more. I should say, generally speaking, the lead 7500
joints cost a little more than the riveted. You can make some bends with straight pipe on the lead joints that you would have to otherwise buy, and that applies particularly to the pipes in the downtown District No. 1. It does not apply so much to District No. 3.

Mr. Hazen: I estimated it all with riveted joints, and assumed that the extra cost of lead joints, if any, would be handled in the allowance I made for accessories. I don't think there would be an extra cost for lead joints in No. 1 and No. 2 Districts, but I think probably there would be an excess in No. 3 District, because you

would have to have so many special pieces and riveting made to get by the different things, that I think it would more than offset any saving that could be made. Those special pieces could not be made in advance, because it would not be possible to determine what would be required until the trench was opened up. It would be special work, rush work, and would run into money fast.

Dillman

Witness: GEO. L. DILLMAN recalled for Defendants.

7501

DIRECT EXAMINATION BY MR. SEARLS.

Dillman's table on relative cost of riveted wrought iron pipe in the city, in the various districts, as compared with the cost in the country, introduced and marked "Defendants' Exhibit 151".

This table was made from my estimate, and the estimate is not based on this table. The first column shows the size of the pipe; the second column the weight and the thickness of the pipe; the third column shows the kind of joints, whether lead or riveted; and the fourth column the cost per foot laid in the country, which is according to the schedule of riveted pipe which I put in when outside riveted pipe was considered. I used the earth excavations in the country. This takes into consideration the extra cost of excavation, and handling of obstructions. It is only my idea of the extra cost which would be necessitated from the change in conditions. I roughly compared these figures with the increased cost which Mr. Hazen showed in his Exhibit 98mm. It does not show that there is a very wide variation. The difference in the two estimates is more largely in the base price than in the changed price. The addition for the city conditions, while different, seems to be not largely different. We
7502 are within hailing distance of each other.

In making my estimate, I have been guided by the inventory, so far as it states anything, and by the agreed stipulation as to the character of the material in those districts. The relative difficulty of obstructions to be overcome is a matter of my own opinion. My base prices for riveted pipe have been figured on the theory that the reproduction value of a wrought iron system would not be greater than a steel system, and the same rule applies to my city distribution—wrought iron. I think there is no necessity for a greater diameter of steel in order to substitute a riveted steel system for the wrought iron. The coefficient of friction is different between one material and the other, but the coating is the same, whether it is steel or wrought iron. I see no reason for that addition. I have used the same basis here identically that I used in the country riveted
7503 pipe, both so far as the cost of the metal and the fabrication went.

Witness: ALLEN HAZEN for Plaintiff. 7504

CROSS EXAMINATION BY MR. SEARLS.

This table which you have handed me seems to be a fair calculation of the segregation between the shop fabricating costs, and the laying, caulking, and riveting costs.

(The table referred to consists of computations by Mr. Ellis from the schedule introduced and marked "Exhibit 98jj".)

It is putting a construction on the table which I would not have thought of using it for, and which I do not believe is justified by the data; this table was made up for our office use, and the different columns—A, B, C & D—represent the different bases on which we have calculated the data and classified them, and the differences between the successive steps are put in approximately for 7505
the purpose of discussing the cost data that we got. Now, when it comes to subtracting each column from the next, and saying precisely that that is my estimate of just exactly what is represented by the difference, I think that is perhaps going a little farther than I should care to admit the accuracy of the table.

In view of the relationship which these columns show, and the fact that they are based on my office experience, I would not say that this price of 2.57 cents per lb. would very probably approximate my experience shop excavation cost, even when resolved in accordance with the changes I made when applying Eastern figures out here, because I took that schedule as a basis for making this calculation. The schedule, in a general way, does reflect our experience with prices; it was made up some time ago, and the experience we have had since perhaps indicates that the schedule is a little low. We have been disposed to add a little something to it, rather than subtract from it. There was an addition for the extra cost of the work in San Francisco as compared with the East, and it would be my impression, without having thought of it before, that the excess cost would be more on the trench work, and less on the shop work, and that pro-rating that, I don't believe that would be quite a fair distribution. The trench work is not included here, but I mean putting the pipe together in the trench, riveting it and caulking it. It seems to me you would have more of a relative advance in that part of the work than in the shop work, so that instead of distributing it pro-rata, I am disposed to thing it would be distributed in some 7506
other ratio. I don't know that I can tell you the ratio in which I think it should be distributed, as I had not thought of it along those lines, but I should think the excess would be more on the trench work. I have added 20% for the entire amount as an average. I don't think I could make a precise calculation as to the division I desire, but with that reservation, as far as I see, it looks like a very

fair calculation from the data. Taking it with those limitations, I
7507 don't see why it is not fairly made.

This sheet prepared by Mr. Ellis is as follows:

7508 Referring to A. Hazen's figure of 3.75 cents per lb., covering shop fabrication, hauling, laying and profit.

The was derived from a development of Hazen's Office Schedule, October 30, 1912.

On page 1 of Hazen's discussion, Exhibit 98j, he shows **4.2 cents per lb.** for pipe of ¼ inch plate, complete, including material; of this 4.2 cents per lb., **2.5 cents per lb.** covers cost of transportation, dipping, laying and profit.

He estimates that for 3/16 inch plate the item of 2.5 cents would be increased to **2.86 cents per lb.**, an increase of 14.4%.

To this base of	2.86	Page 15, Exhibit 98j.
He adds for S. F., condition 20%	0.57	
Giving	3.43	
And to resolve it to a basis of metal only, adds 9.4%	0.32	
Total	3.75c	

Mr. Searls endeavored to obtain from Mr. Hazen a segregation as to how much of this 3.75 cents represented shop fabrication, and how much laying and riveting in trench. Mr. Hazen did not make this analysis, but did furnish a copy of the "Schedule of October 30, 1912", the blue print attached.

An examination of this shows a segregation of items on a slightly different basis than the Exhibit 98j.

Column B shows the basic figure for pipe of ¼ inch plate, **4.2** cents per lb. laid, riveted and caulked, including material, this being identical with the same base used in the exhibit.

Column A shows the cost of pipe f.o.b. cars.

The difference between A and B is 0.5 cents per lb., covering hauling to ditch, laying, riveting and caulking in trench.

7509 If we develop this figure in accordance with Hazen's methods, we have:

Base ½ cent per lb.	0.5 cents
+ 14.4% for 3/16″ plate	.072
	0.572
Add 20% for S. F. conditions	.114
	0.686 cents
Add 9.4% to resolve to metal basis	.066
Total	0.752

If the above assumptions are correct, it would appear at 0.75 cents, or $\frac{3}{4}$ cents per lb. represents the cost of hauling and laying in the trench in Hazen's figure of 3.75 cents. This would apparently leave 3 cents per lb. for dipping and shop fabrication. Dipping is agreed on at 0.43 cents per lb.; deducting this would leave 2.57 cents per lb. for shop fabrication, and railroad freight to point of team haul.

Mr. Hazen: That .257 I think includes all the expenses that there are from the plates to the pipe delivered along the ditch, and that statement is inaccurate to the extent that it says 2.57 cents per lb. for shop fabrication and railroad freight to point of team haul. It also includes an item of considerable importance that is not covered by Mr. Dorward's testimony. For instance, it includes making
all the bends and man-holes, and the blowoffs. Mr. Dorward's 7510
figures were for the straight pipe only. That is quite an important item. In making this comparative statement between Mr. Dorward's table and mine, I assumed his original figure of profit.

Mr. Hazen: My estimate of the cost of manufacture, including 7512
the transporting and laying, as an average for the thick and thin plates in the system, and not including some lines for which a smaller allowance was made, but only the lines of what I should call standard construction, was 3.75 cents per lb. To compare that with the figures which Mr. Dorward used, and with the figures of the actual contracts let by the Spring Valley Water Co., two items must be deducted which are not covered by the estimate, or by the contracts; one is for dipping, which amounts to .43 of a cent per lb.; the other is for making the bends and man-holes and blowoffs, which amounts to .3 of a cent per lb., as I estimated it, based on the actual record of the lines I could get of this company, and corroborated by records of other lines. That makes a deduction of .73 of a cent, which leaves 3.2 cents as my figure, reduced to a basis of comparison with the contract prices, and with Mr. Dorward's estimate. Now, Mr. Dorward estimated on actual cost, without profit, for doing the work represented by my estimate of 3.2 cents for 30-$\frac{1}{4}$ inch pipe, 2.61 cents per lb.; for 44-inch No. 6 pipe, 1.971 cents per lb.; for 44-$\frac{1}{4}$ inch pipe, 1.735 cents per lb.; 54-9-32 inch pipe, 2.098 cents per lb.; the 9-32 is not in accordance with the records, but that is perhaps not material for this purpose; it is what Mr. Dorward used.

The average of those four items is 2.103. Those are the only items I found in Mr. Dorward's testimony that I had at the time that I can use in this way. If there are others, I overlooked them. These items are for the thicker plates. He didn't give any corresponding figures for thinner plates. The 3.02 cents of mine is an average for the whole system. The cost is a good deal more for thinner plates, and less for the thicker plates. If Mr. Dorward's
estimate were extended, and covered all the plates, I think that this 7513
figure, instead of being 2.103 cents per lb., would be quite a little

more than that. I have not any way of knowing what he would estimate that. I simply point out the fact that there is a difference there, and a difference of considerable importance, as I think. Now, with a 35% profit, which Mr. Dorward suggested as suitable, that would increase the average of those four items to 2.84 cents per lb., which is comparable, except for the fact that the thinner plates are not represented in it, to my figure of 3.02 per pound. Taking into account the difference in plates, it seems to me that Mr. Dorward's original figure practically is exactly in agreement with my estimate. If Mr. Dorward's percentage of profit were reduced to a smaller figure, that would obviously change the comparison. If 15% profit were added, it would be still neglecting the difference in thickness in place. It would be 2.419 cents per lb., as against my 3.02, but when we consider that this profit is reckoned on the work only, and that no profit whatever is allowed on the materials, I would say, as a matter of my own judgment, that I don't think any manufacturer would do business on that basis. This means that not more than 6 or 7 percent profit on the whole job is made, and I don't think any-
7514 one would figure as close as that. I don't know what profits pipe plants get on these fabricating jobs, and I don't claim to know that.

Questioned by Mr. Searls.

I did not make any definite conclusions as to the cost of laying pipe for the high pressure fire system in the city streets. I simply
7515 noted that it cost considerably more than the figure I estimated for the Spring Valley reproduction. I have the contract prices on eight contracts, three contractors failed, and five carried the work through, and I made a summary of those. I said that the average cost of excavation on those high pressure contracts was $1.23 per cu. yard. I don't think I can state as to whether that included the excavation of trenches to a greater depth than the Spring Valley trenches were excavated, but assuming that it is correct, I do not think it would involve a higher proportionate cost for lagging.

I was not figuring on trenches less than 3 feet deep in any
7516 event. If it was unnecessary to lag it 3 feet, I should doubt if it would be necessary to lag it ordinarily at 4 feet or 5 feet. Of course it might be in some cases. I think 3 feet would be the minimum depth of trench. I had the information from Mr. Elliott as to the average depth. For the cast-iron, this was based on 30 inches of cover. I don't know that I made any direct use of these high pressure costs. It was simply one of the things that I inquired about when I was trying to get pipe-laying data, and I did get the contract prices, and I considered them for what I thought they would be worth. I recognize that my estimates were not on as high a basis as were represented by these costs. I think the average diameter of cast-iron pipe in the city streets, laid by the City, for the high pressure fire system, was somewhat greater than the average laid by

the company in the city streets. It sounds reasonable that the average of the fire system pipe was about 12 inches in diameter, while the average for the Spring Valley's cast-iron pipe was between 8 and 10 inches. That would mean that the total amount of surplus to be hauled away would in the aggregate be somewhat 7517
greater.

The riveted pipe on the high pressure fire system is much larger in size than the cast-iron pipe in either the Spring Valley system or the high pressure fire system, and my prices were based on cast-iron prices for the same sizes, so that any difference there might be in that respect would be taken care of. I did not inquire particularly into the depth of the Spring Valley Co.'s trenches. I got it from Mr. Elliott, and my calculation was based on an average cover of 30 inches. The depth runs 35 inches for the 4-inch, and 56 inches for the 24-inch cast-iron pipe. It is deeper in proportion as the size was larger. If, as you say, the average of the fire protection trenches was about 5½ feet in depth, that would be considerably deeper than the average Spring Valley trench. I cannot say whether in the case 7518
of the high pressure system the trenches were left open for several days until after a test had been made under pressure. I didn't see any considerable amount of it. I should assume, in the case of the Spring Valley pipe trenches, that in no event would the backfill be made until the joints had been completed, and pressure put in, and the pipes fully tested. I don't know what the experience of the company is in that respect with riveted pipe.

Mr. Elliott: I think it is 600 feet of trench that you can have open at any one time, under the City Ordinance. If you are going along with your work, you have to keep backfilling behind so as to not have more than 600 feet open at any one time.

Mr. Hazen: Assuming that the ordinace is obeyed, I don't think 7519
it would make any difference about the cost of maintaining the bridges, and the barricades, and the lights and the watchmen, to which I referred. Of course, if they were kept open for a long time, it would mean more watchmen, and all that sort of thing. I am assuming that a trench would be left open long enough to do the work in a workmanlike manner. It may be that you have some city ordinance which makes that impossible. I did not take any such handicap into account in making my estimate. I assumed that the work would be done in the ordinary way, that it would be laid and fully tested out before it was backfilled. As a practical proposition, you would need more than 600 feet to test. It would increase the expense if you had to fill up all except 600 feet. It would mean leaks, likely, and it would mean a permanent loss of water, and it would represent a drain on the resources of the company.

Mr. Elliott: We test our pipes. We have two bump-heads on; 7520
we put a casing over the end, and put a pressure on the pipe for

400 or 500 feet, or whatever it may happen to be, and that means extra expense. It would be much cheaper to lay the pipe if we could have 2 or 3 miles open at a time.

Questioned by Mr. Searls.

Mr. Hazen: If there was trouble from water anywhere, that would add to the expense of handling the pipe in the deeper trenches, but I did not assume there would be any difficulty with water in laying any part of this system. I don't know whether that was the experience of the fire protection system, or not. I would not say that where you have a trench 5 or 6 feet in depth that you are apt to encounter the tops of concrete sewers, and other structures of that sort. I did not inquire into the sewers in San Francisco, but in other cities the sewers are deeper than that. I should say that the cost of digging a 5 or 6-foot trench would be less per cu. yd., through downtown streets, than digging a 3 or 4-foot trench. It would be less per cu. yd., because you have most of your troubles near the
7521 surface; when you get by that trouble the extra cost of going down as far as a man can throw the excavation up readily, it is only the ordinary cost of excavation. If there were such troubles as encountering sewer catch-basins, and so on, that would modify the statement that I have made, but I would not expect that up to 5 or 6 feet.

The maximum depth of trench for riveted pipe is 74 inches as an average. Of course, it would not be the same everywhere; it would be shallower in places, and deeper in other places. Wherever you encountered obstructions, you would have to put in bends to go by them, or else move the obstructions. My experience with large pipe is that we more frequently remove the structures that are in the way than go around them. I don't think that would be impracticable in the case of the high pressure system. I don't know what
7522 their procedure was in laying that system. I think they could stand as much deviation as we could stand on these riveted pipes.

ONE HUNDRED AND FOURTH HEARING.
FEBRUARY 25, 1916.

Witnesses: G. A. Elliott for Plaintiff.
Joseph Jas. Phillips for Defendants.
Leslie W. Stocker for Defendants.
J. H. Dockweiler for Defendants.
Geo. L. Dillman for Defendants.
Allen Hazen for Plaintiff.

Witness: G. A. Elliot for Plaintiff. Elliott

CROSS EXAMINATION BY MR. SEARLS. 7524

My testimony as to the cost of pipe was purely an arbitrary assumption. The weight, for instance, which I had to obtain to get the laying cost per pound, I computed from a modification from the formula which is in the American Engineers Handbook. It is 98% of that formula. 98% of 12½ times the diameter times thickness plus 10.

Mr. Hazen: The formula that Mr. Elliott speaks of is the formula published in the American Civil Engineers Pocketbook, and that I used for computing the weight of steel pipe, ¼ of an inch, or more, in thickness, and larger sizes, and I found it was not strictly applicable to the Spring Valley pipes, so I did not use it in this case in the final calculations. It was used in many of the preliminary calculations, but the weights I have given you were not computed by it. I don't think I used a modified formula. That is to say, some of the plates were bought by gage, and some by weight, and I varied it to meet those conditions, so that they were not figured by any formula.

CROSS EXAMINATION BY MR. SEARLS. 7525

Mr. Elliott: In taking my base cost of the pipe, I did not assume Mr. Hazen's figure on that, nor did I base my estimate on the last two or three contracts that the company had. I assumed a somewhat arbitrary figure on that, based partly on the exhibit that Mr. Lawrence put in on the country work. I gave practically no weight at all to the last contract given to the Schaw-Batcher Co. for fabricating the pipes across the park. That pipe was made up in a hurry, and there were no specifications, with the exception of about one paragraph as to manufacturing pipe. There was practically no pipe work going on at the time. In fact, Mr. Batcher tried to get me to interest the company to buy his shop, he was doing so little work. That pipe was not riveted up to the full standard. It has to stand a working pressure of about 75 lbs.; the plate from which the pipe was made was used because we had it on hand. As a matter of fact,

the plate will stand really very much more than 75 lbs.; they used great deal stronger plates there than was necessary for the work as far as the pressure was concerned. That was the steel pipe. In saying riveted up to the standard, I mean riveted up so as the joints would be as strong as the plates themselves. I did not have any other
7526 recent costs of pipe fabrication that I used. In regard to that figure of cost to manufacture, I would just as soon have taken Mr. Hazen's figure, or anybody else's figure on which to base my future cost. It is purely arbitrary, and should be looked at that way. My assumed cost of fabrication is shown in the table that was put in.

The cost of laying and riveting, and the cost of the trench work, were based on my experience with the Spring Valley work. The dipping is an arbitrary figure, and is included in the manufacture and delivery of the pipe. My figures cannot be wholly correlated with those jobs on Sloat Boulevard, Merced Ranch, and Golden Gate Park, because some of the operations are common to cast-iron. That refers to the trench work, and while the lead work costs a little more in the case of wrought iron pipe, it has some relation, of course, to cost of the cast-iron.

I was on the pipe laying at Deer Creek Power House, which was a riveted job, and rather a difficult one. I have not used that in any way, but I have had that experience, and also on the Centerville Power House.

The figures that I have mentioned here, I do not think it would be
7527 possible to ascertain from the company's books, it so happened that I kept field costs, and I have the data in my note books. In my totals I was within about .1% of the figures shown on the company's books. I have them segregated, and I do not think the company has segregated them. My notes were kept by the timekeeper, and they show the timekeeper's costs of the work. The teaming was obtained from the same records from which I obtained the rest of the work. I do not think that you will find any freight. We have a record of the lead bought by the company for a good many years, and I took the average cost on that of 5 cents per pound. The quantity used in the various joints is a matter of record in my note books from the timekeeper's reports to me.

7528 The pipe in the park is made up from data from an inspector that I kept on the job; after the work was finished, I went through the company's books in connection with the data that he has, and sub-divided the entire charge. Since he did that, there was an additional charge, which amounts to about .1 of 1%, which has been made by the auditor, which I have not bothered about particularly. It is immaterial.

7529 Questioned by Mr. Greene.

As far as that job in the park is concerned, my statement is that that pipe is under-riveted.

An exhibit entitled "Joint Exhibit, Gross Reproduction costs of "pumping stations, excluding engineering, contingencies, etc., and in- "terest during construction, as of December 31, 1913", was introduced and received as "Plaintiff's and Defendant's Exhibit 152".

A copy of the contract between the Peoples Water Co., and the 7530-7531
Piedmont Paving Co., for the construction of the Central Reservoir, was introduced and admitted as "Defendant's Exhibit 153".

Phillips

Witness: Joseph James Phillips for Defendants.

DIRECT EXAMINATION BY MR. SEARLS.

I am 37 years of age, and reside at 504 Belvedere Street, San Francisco. I am employed by the City and County of San Francisco as a building appraiser and right-of-way agent. During the period from 1907 to 1913, inclusive, I was a building inspector, associated
with the firm of Rainey & Phillips, of this city. We specialized mostly 7532
on brick construction. I had been associated with Mr. Rainey since January 1, 1902. We specialized mostly on city construction, though at times we went out of the city. We have done some gas work out of the city, and we built the smokestacks of the Remillard Brick Co., at San Jose, and Pleasanton. We have constructed probably 400 or 500 buildings in San Francisco since 1902. The Hotel Federal is one, Prager's is another, another one in the same block is the department store; we built the terra cotta and brick front of the Columbia Theatre; quite a number of hotels; we built one at Bush and Grant Avenue, and buildings like Baker & Hamilton's building, the Lochman Estate; apartment houses like the Natalie on Stockton St.; Mr. Heller's residence, on Jones St., and Mr. Hammond's residence on Fillmore and Broadway.

We have done quite a little boiler work during that time. We built nearly all the boiler foundations for the City Electric; we built some for the San Francisco Gas & Electric, the Equitable Gas Co., the Metropolitan Gas Co., and various other small jobs for boiler
foundations. Prior to the time that I was engaged in the contracting 7533
business, I was a bricklayer, both as foreman and journeyman. I was a union man, and at one time held the office of President of the Bricklayers' Union. I am thoroughly familiar with the rules and regulations of the Bricklayers' Union for the past 8 or 10 years, concerning wages, hours, and general regulations. The Bricklayers' Union, either in San Francisco or the State at large, during that period had no regulations restricting the output of bricklayers. That was one of the main principles of the Bricklayers' Union never to allow any rule to restrict output; that has been upheld by the International Association, the B. and M. I. U.

Since shortly after the fire, the standard rule as to wages and hours for bricklayers in San Francisco has been $7 a day, and 8 hours.

I am familiar with the union hours and wages in the State of California outside of San Francisco by being told by union men. I have estimated some work in the country, for which I did not receive the contract, investigated the conditions, and found that they were exactly the same as they were in San Francisco. I have visited various cities throughout the State, and ascertained the conditions there from
7534 time to time. I know the regulations of the unions in Sacramento and Los Angeles, and other cities throughout the State, affecting hours and wages. Those regulations are the same as the regulations of the union in San Francisco. It would not cost more to do brick work in the city than it would in the country. The reverse would possibly be true, if there was any difference. If a man had a small job in the country, it would cost him a little more, but if there was a large job, he could do it practically as cheap as in San Francisco. As a rule, the work in San Francisco would be a little cheaper.

I would not add a little to the city work to get the country price.
7535 Just the reverse is true. I would say that country would cost more than city work. When you are doing a job in San Francisco you have plenty of men, and if a man does not suit you, you can fire him immediately and hire another man, but in country work if a man doesn't suit you, you might let him work till the end of the day or the end of the week; you have not the competition in the country that you have in the city. In the city you can carry things on with everything at your command, and in the country you cannot always do that. For that reason the city work should be done cheaper than work in the country.

I have seen some of the brick structures of the Spring Valley Co.; I have been in the tunnel under the Crystal Springs Reservoir; I have been in the tunnel at Lake Merced, and I have seen that drainage culvert out there in connection with the drainage system. I visited these properties, not for the purpose of making any appraisal, but simply in company with other appraisers of the city who were appraising various portions of the Spring Valley plant. I examined the brick work in question at that time. I was not called upon at the time
7536 I was visiting these different works to really appraise them, and I have not given the matter any particular thought, except that I considered that after having been 15 years in the business, I can look at any piece of brick work, and give you some idea of what it is worth.

Questioned by Mr. Greene.

In the culvert at Lake Merced I saw how many layers of brick there were. That is not true of the tunnels, because I had no way of passing on that. I have heard, in years gone by, of the method in which those tunnels were constructed. If they were of unusual thick-
7537 ness of brick, it would cheapen my prices, and by "thickness" I mean the number of rolls that are used in the tunnel construction. The thicker the lining, the cheaper the work.

DIRECT EXAMINATION BY MR. SEARLS.

Taking the Merced Culvert, I should believe that work would cost about $25 a thousand, laid in place, and a mason would lay, on work of that sort, from 800 to 1,200 brick a day. In the tunnels I would figure a man would average about 500 brick, and that work would run along about $36 a thousand. I think it is good practice, in making a hydraulically tight wall, to put a little lime in the mortar.

Mr. Searls: Q. It has been testified here by Mr. Hazen, that in some brick work which he had in Albany he found it impracticable, working under union conditions, to get his men to lay the mortar and push the brick down into it. They insisted upon putting the mortar on the brick, or buttering it, I believe it is called, before laying, and that he could not get a water-tight wall in that way. Will you say whether or not those conditions would exist in San Francisco, in view of your experience in this work?

Mr. Phillips: A. Positively no. Was Mr. Hazen referring to a pressed brick job, or common brick job, on hydraulic work, when he made that statement?

Mr. Hazen: We were building brick walls in hydraulic con- 7538
struction to carry water on one side, and not on the other side; this work was started before the union days; the practice was to carry up a 4-inch brick wall on either side, and put buckets of Portland cement mortar in the middle, and then push the brick down into it until they were submerged, and in that way a perfectly tight brick wall could be made. We always built them way up to about 1897 or 1898, when the bricklayers organized into a union, and insisted that they would not lay brick in that way; they had to be laid with a trowel, and that union men would not lay bricks except with a trowel, and the same wall, laid with the same mortar, and the same proportions with the trowel, as we discovered from experience, actually leaked. We could not get the results that we got by the older methods.

DIRECT EXAMINATION BY MR. SEARLS.

Mr. Phillips: There always has been a rule among bricklayers not to allow a man to use a shovel, and you will find in their rules that a bricklayer using a shovel for the handling of mortar into the wall from a mortar bed would be fined. Possibly it may have come under that heading, where they put it in buckets. The bricklayers always insisted that a man use a trowel, but there is no reason in the world why a man connot use a trowel and do an absolutely tight job. In fact, if I was to do the work for myself, I would insist upon the man using a trowel, because with a trowel he can place this mortar so as not to have an unusual amount of mortar in one place; where a man handles it with a shovel, or a bucket, in putting the mortar into the tunnel wall, he gets too much mortar in one place, and as a result it is a lot of work for the bricklayer to shovel that off, it coming up 2 or 7539

3 inches. Oftentimes he will leave it with 2 or 3 inches between the brick themselves, which is a bad feature, so that if I were doing the job myself, and wanted to get what I considered the finest kind of a job, I would not allow a man to use a bucket, or to shovel the mortar into the wall. It can be done with a trowel, and that would be the proper way of doing it.

As a general rule, I would say it would not be difficult to get the bricklayer to spread his mortar carefully with the trowel, wet his brick, and then press it down in the mortar, so as to procure the necessary tightness of joint. My experience has always been that a bricklayer will give you any kind of a job you ask for. Taking it as a rule, a bricklayer will give you a thoroughly rubbed-up job if you want it.

I did some concrete work shortly after the fire, and probably 10 or 15 years ago. I was foreman on the concrete work on the foundations of the Affiliated Colleges, and have handled concrete in small lots, but as a rule, I have always sub-let my concrete work. I have generally figured myself, and after I secured the concrete, then I take figures from regular concrete men, and let the work to them. That was for building foundations, sidewalks, and work of that character.
7540 As a rule, on concrete foundations, for one to five-story, or six-story buildings, some place the wall 13 inches, some 17, and some 21, and running as high as 25, running in heights from a foot or two, or three feet, to a basement of 10 or 12 feet, and as an average I have allowed 25 cents a cubic foot. I have always found that I could let the work under what I had figured, and make a profit on it. At 25 cents a cubic foot, it would be $6.75 per cubic yard.

Questioned by Master.

I would say that from July 1, 1907, to the middle of 1914 that those prices would be fair.

7541 CROSS EXAMINATION BY MR. GREENE.

On ordinary buildings the cement would generally run from $1 to $1.25 per thousand of brick. I don't know what the cement cost per barrel for the concrete construction. I bought cement for the brick work, and we have always paid more for cement for brick than the concrete men have for their cement, because we do not handle as much, and we have not the place on the job where the bricklaying work is going on, to store it, and we very seldom buy it in carload lots; it has generally run about $2.10 a yard to the bricklayer. The concrete men buy in carload lots, and they have bought it on some buildings as low as $1.50, and $1.65, $1.70, $1.80, $1.90. They have always been able to buy cement cheaper than bricklayers, because they buy it in carload lots. Sometimes I have taken cement over from the concrete man which he had left over from his foundation, and at those times I would take it over at a less price than $2.10. I do not know what was the cost of gravel that was used in my concrete work. I do

not know how many barrels of cement were used per yard in my city concrete work. Most of these specifications call for a mix of 1 cement, 7542
2 of sand, 4 of rock.

I do not suppose that I have ever constructed a brick wall in connection with waterworks which was to be wet on one side, that is, with standing water on the inside. Most of my experience during the years in question was in the construction of town buildings.

There are quite a number of union restrictions under which bricklayers work. For instance, they have a rule that the line on the inside, or the outside facing of the wall, should not be put further than one course at a time, except where something comes in the way; and if it is over a piece of steel or wood in the wall, it is necessary to put the line over five or six courses at a time, and they allow it, but they have a rule that it shall not be put over one course at a time. They have the rule in regard to not being allowed to use the shovel, which, I think, is a good rule. I know of one rule in particular where they insisted that if a certain number of men were working on the job, that there should be a foreman bricklayer over them; they never en- 7543
forced it; they did attempt to enforce it two or three years ago; they never had any trouble about it. There are quite a number of rules of that character.

I don't know of any brick tunnel that I have put in, though I put in work that was somewhat of a similar nature, like gas machines, and around a gas works. The further you get into the tunnel, the cost of handling material would be a little more. In this gas tunnel that I mentioned, the work was arch work. I have kept a complete cost of all the work that I have done, and I have studied the business from A to Z, and even went so far as to invent a system of brick construction that was never known before, and which is used very extensively in San Francisco now. I cannot remember of any brick work that I have done in a tunnel.

The number of bricks that you would lay to a cubic foot in ordin- 7544
ary brick work is a proposition that fools everybody outside of the business. Engineers will figure 18 brick to the cubic foot, and nobody in the business figures 18 bricks to the cubic foot; we figure 18 bricks to a brick and a half; there is a difference of about 10% or 12%. I have often seen people figuring up brick work to tell how many brick are in it, and probably they will be anywhere from 10 to 15 percent away from what the practical man would figure, and about 25 to 30 percent away from the actual number of brick in the wall.

Questioned by Mr. Searls.

They would have more brick than really were in the work. Men in the business figure 6 brick to a square foot for every half brick thickness of wall. Walls will lay up to 12 to 13 inches in thickness, and if a man was to figure 18 brick, he would be figuring about 20 brick, or 20½ brick, as against the practical man's 18, and even at

that, when we figure 18 brick, we don't add any percentages to our work afterwards, because we know that figuring 18 brick to the 13-inch wall, that there is enough margin on the brick that we don't put in there to give us a considerable profit. In fact, in nearly all my work in figuring 18 brick to the foot, I do not add any profit, and then I would make a cut from the total figure, knowing that I could cut at least 10% out of the job.

CROSS EXAMINATION BY MR. GREENE.

Brick has averaged during this period mostly \$6.50. I have paid \$7—that was after 1913, but most of the brick was purchased
7545 at \$6.50, I think. There is a difference in the quality of brick, but all common brick comes into this market at the same price. Some years prior to the fire it was the custom to select a soft salmon brick; they were called chimney brick, and were sold for 50 cents more a thousand. That was along about 1902 when that practice ceased. Then with the improved process of making brick, it was not necessary to do that any more, as it would be hard to find, if the brick were properly burned, as they generally are, any soft brick among them, so that from about that time on there were no cheap grades on the market. Sometimes a man would want an extra nice job on the front of a building, and he would pay anywhere from 50 cents to \$2 a thousand to select them for various purposes. During the years 1907 to 1914 the brick sellers here did not have two or three different prices for bricks of different grades. In the case of a hard-burned sewer brick, that should be vitrified brick. In that case there
7546 is no common brick at all. Assuming that they are not vitrified, a man might attempt to select them for sewer construction. I don't know that hard-burned brick does cost more, or that it does not cost more than ordinary red common brick. There has only been one grade of common brick in this market for years, and of course sold at varying prices, depending on the man buying it. I know that the Sacramento Transportation Co., for instance, does not segregate any brick in its yards for any purposes. They are common brick. I think that I have heard in the past that McNear has at times selected brick for special purposes, but the Sacramento Transportation Co., one of the oldest and largest concerns in the business, does not segregate any brick at all out of their pile for any purposes, sewer or anything else. I am familiar with some of the yards; I
7547 am familiar with the Sacramento Transportation Co.'s yards. Of course, it is impossible for me to say that a man has not gone into some particular yard and paid a special price in order to satisfy some whim, possibly, or had some well defined reason for getting brick of a peculiar kind. I couldn't say whether or not the brick-yards here have sold brick of different grades during this period of 1907 to 1914. I don't know whether some companies have charged

extra for hard-burned sewer brick over the common red brick, or not. I don't know whether there was a common trade practice to charge more for that than for the ordinary common red brick.

I made the single exception of the Sacramento Transportation Co.'s business because I have bought millions and millions of brick from them, and have been in their yards a thousand times, I think, and they make no difference, whatever. They have one grade of brick. I do not want to be misunderstood when I speak of common brick. There is a kind of brick used for base purposes called clinker brick. In their old style of burning, they had a salmon brick, and then they had the hard-burned brick. Now they have a hard-burned brick, and a clinker brick; these clinker bricks are just black, over-burned brick; with that exception, the Sacramento Transportation Co. does not segregate its brick at all. 7548

The brick work in the construction of the drainage tunnel at Merced is a very good job. That is the open structure to the east 7549
of the lakes, and that is what I estimated at $25.

Referring to structure 5 at Crystal Springs; the gate tower I certainly would put lower than $36.

Mr. Hazen: The intake pipes leading from three different levels to the gate tower are the tunnels that were lined with this flanged pipe, and then the brick was laid in between the pipe and the wall to fill up the space; that is very difficult work that could not be seen by anyone. That was estimated at $50. It is on the back side of the dam. They drove a tunnel through the back of the cut; it is under the water; the pipe goes through the tunnel, and then the space between the pipe and excavation was filled in solid with brick, so that is much more difficult work, and is estimated at a higher price. 7550

Mr. Phillips: In building in San Francisco I could itemize the cost from A to Z, but on the two jobs I had the work was done in the brickyard, and they furnished the brick; in fact it was their work and their brick and no track was kept of that, so that I could not tell you what it cost on those two jobs. These stacks were built during the high period right after the fire in 1906, when we had a hard time getting men, and I had to spend considerable time there myself. On those chimneys I would get at least 1200, and possibly 1500 to 1800 brick to the man.

I stated that there are no restrictions placed upon the amount or the number of brick which bricklayers will lay, anywhere within the state, but I can say, that I do know this; we had this thing 7551
up with the International Union; knowing that one of the principles of the International Union of Bricklayers, which covers the entire country, is not to allow any local Union to put any restriction on the output of their men. There is this restriction: The International Union insists that every year the local Union sign up an agree-

ment of working conditions with the employers; if anything comes up that a local Union tries to break that agreement, or if no agreement exists, tries to establish a rule, such as you speak of, of limiting the output of the men, all that the employer would have to do would be to notify the International Union, stating the condition of affairs, and the International Union would insist on the local Union abrogating that rule, and if they did not do it, they would take its charter away, and put other men in here, and form another Union, and put the Union out of business. I have had those things up with the International Union when the Union here was trying to do things we did not wish, and that was the ultimatum delivered to the Union here, that they must not go beyond certain lines or their charter would be revoked. That was some three or four years ago. I am not sure whether the brick work on the Hobart Building at Montgomery and Market Sts. was actually suspended for some time
7552 as a result of that or not. There have been various little matters arising from time to time where we did not think the bricklayers were acting quite right, and we have taken it up with the International, and have always gotten satisfaction from them.

It is my understanding that there has never been, in California, any restrictions as far as the number of brick that are to be laid per man per day is concerned. I have never heard of any rule of any Bricklayers Union where any restriction is put upon the men, either as to the number of common brick or pressed brick, or terra cotta to be set, or anything else. There is no custom in the trade whatever, no practical restriction. My experience with the Bricklayers Union has been that you can get all the work out of them that it was possible to get out of the men.

RE-DIRECT EXAMINATION BY MR. SEARLS.

7553 As a rule, I expect to average at least 2,000 brick to the man, and I have kept track, out of curiosity, of the number of brick laid by a crew of men in a certain period. I remember a three-story building on Market St., this side of Larkin, built just before the fire, when I took 6 bricklayers on the job myself, and at the end of the day I counted the brick in the wall, 18 brick to the foot, or 18 to 13 inches of actual count, and I averaged either 3,747 or 3,752. It was very close to 3,750. I have worked where something like 4,000 were put in in a day, but a man cannot do that day after day.

L. H. Sly has worked non-union men in San Francisco for years. His foreman told me it was a losing game. I would not have non-union bricklayers, because I don't think I could get the work out of them. I would rather pay $7 to a competent man than $4 to an incompetent man. Naturally, a competent man is going into the Union, because he is going to get the money. A man who is incompetent, and cannot earn wages, is the fellow who is forced to stay

out of the Union in order to make a living, if he is going to follow that business, but if he is competent at all, he is going to be under the Union rule, and get Union wages.

Questioned by Mr. Hazen.

It is not as easy to lay a brick in Portland cement as in mortar.
Portland cement is much more difficult. If you can put a small 7554
percentage of lime in the mortar, you can do better work. I consider a man can do better work than he can in sand and cement, though engineers insist on doing it.

Questioned by Mr. Greene.

In sand and cement, without any lime at all, it keeps a man busy to put in a thousand in a day, where he would put in 2,000 with lime. I have built lots of brick walls where I had standing water in back of it. Any man in the building business, where he put in brick foundations, has had that experience. I have had it in San Francisco in a number of cases. I did not want to go beyond my experience, and I did not understand the question before, when I was asked if I had ever built a wall that had water in back of it.

Questioned by Master.

These walls that I speak of are cases where the wall must not
leak, absolutely. It is a hard thing to put in any brick wall, even 7555
in sand and cement, with standing water behind it, and make it absolutely water-tight, because the water will go through the brick. It goes through the mortar as well as the wall. I do not consider that you can get any brick through which water will not pass, outside of vitrified brick. Water will pass through any common brick that is made. Vitrified brick is made out of a clay which vitrifies, and leaves a sort of a glaze on the surface. The glaze isn't put on, it is in the clay.

Questioned by Mr. Searls.

That brick costs about $35 a thousand. I could not say whether with that kind of brick that more water would pass through the joints than through the brick itself where a little lime in your mortar is used. I could not tell whether more comes through the brick, or
through the joints. 7556

If a man came to me and told me that he had a certain place where he had to use brick work, and that he had standing water in back of the wall, I would put in a certain proportion of lime in that work, because I know by doing that I could get as absolutely solid a job as a man is apt to get with sand and cement. I would consider that if I got the interstices between the bricks thoroughly filled, that I would have done all that I could do toward making it water-tight. If I used lime and cement mortar, I would consider that my wall would be more water-tight than sand and cement mortar. It would depend upon the pressure whether it was water-tight or not.

Witness: LESLIE W. STOCKER for the Defendants.

7557 DIRECT EXAMINATION BY MR. SEARLS.

I am 32 years of age, reside in San Francisco, and am a civil engineer. I am an assistant engineer in the City Engineer's Office, and have been there 8 years. I am a graduate of the University of California. I was engaged about 2 years on the designing of the high pressure water system, and about 2 years on the construction of the pipe system and its auxiliaries. The reports of the cost of doing that work were checked by inspectors working under my supervision.

It is the practice of the City Engineer's Office to keep detailed cost accounts on all contracts that are let for work done in the city, and that practice was followed on the work on the auxiliary water supply system for fire protection. On the high pressure pipe laying contracts there was generally one inspector. If it was a very large job, there would be more than one inspector, whose sole duty it was to make the rounds of the jobs every day and take notes of what the men employed were doing, segregate the different classes
7558 of labor, such as the excavation, pipe laying, etc., and these inspectors would also ascertain the rates paid to the different men, and the rates paid for materials. From these costs of work and materials each day, a detailed cost statement was generally made up at the end of the job. The City paid by contract, and the contractor might have made an excessive profit, or he might have lost money. Inspectors' reports show the cost.

On the contract for laying pipe in the Mission District, I had occasion to check these total costs with the contractor's book costs. The total payment to the contractor on this job was $110,235; the total cost of labor and teaming, as kept by the inspector for the City on that job was $67,919. The total cost, as shown by the contractor's books was $71,876; the total cost of material, as shown by the inspector, is $16,873; the total cost, including an item of $131 charged to equipment, as given by the contractor's books as $10,166. The total for labor and material, as given by the inspector, comes to $84,792, against the contractor's $83,042, an excess in the City's
7559 accounts of something over $2,700. It seems to me that this shows, all things considered, rather a close check.

The contractors are generally not in the habit of keeping detailed cost accounts, and it is quite a frequent occurrence for them to come to the inspectors of the City to find out what a particular element of the work is costing them, and no doubt they use such information in their future work.

The base figures that I obtained for labor and material costs, and teaming, on this high pressure work, did not include any allowance for equipment charges and incidentals which were not covered by the detail report of the inspectors. Such costs have to be allowed

for separately. My costs, as finally determined, was based upon the assumption that a percentage of some sort must be added to take 7560
care of these equipment charges, and the contractor's profits, and overhead and incidentals. In the case of the pipe estimates, I believe that a portion of that overhead charge was added to the total cost of the pipe laid in place, and not added as a part of the cost per cu. yd. of excavation, or per lineal foot of pipe laying, but it was reckoned in the final figure. I took the inspectors' costs on these jobs, rather than the contractor's prices, as the inspectors' costs are a more reliable index to the true cost of the work, because they are the costs. The contractors' prices are the costs to the City, but they are the contractor's prediction of what the cost to him will be, plus a profit. In the job I have quoted, the contractor made a good profit. That is the job I have already given the figures on, totaling $110,000. When I say that the contractor made a good profit, I mean a percentage which a contractor would consider higher than the average. I base that on the contractor's statement to me. He gave me the figures from his own books. 7561

Questioned by Master.

The contractor gave me the total cost of that job, including all of his overhead expense, as $88,024; he received $110,235 from the City, making a profit of $22,210.

Questioned by Mr. Greene.

That includes a very small charge which he made to equipment.

DIRECT EXAMINATION BY MR. SEARLS.

There were several contracts outside of the high pressure system where the contractors lost money, and the inspectors' costs was considerably higher there than the contract prices in those cases. There was one job which was started under my supervision, on which the contractor spent $32,000, doing work for which he was entitled to a payment of $19,000. Some of that excess cost was due to mismanagement, but in any case, his prices were entirely too low. The $32,000 was what my inspector reported as the cost of the work.

Mr. Dockweiler and I went over the available information as to the cost of the trench work in the high pressure system, and after 7562
thorough discussion, we derived from those costs a basis for average costs of the trench work in various classes of soil, and in various districts of the city. The original computations of costs were made in my office under my direction.

A table was here introduced and marked "Defendants' Exhibit "100JJ".

These trench costs, as finally derived, were intended as an average of all sizes and classes of pipes. It is practically impossible to make any segregation for the wrought iron trenches as distinguished from the cast-iron. These jobs covered enough of Districts 1 and 2 in the city so as to be fairly representative of conditions. 7563

Page 24, cost of excavation, backfilling, and removing the surplus excavated material from the trenches. That was derived from the records of the high pressure fire system. The high pressure fire system records of excavation include the cost of opening pavement, along with the excavation costs, and the cost of opening the pavements has been deducted. That is, in order to get the figures which are shown on this sheet, the cost of opening pavements is deducted from the original costs. The original job was on a \$3 wage basis, and this table has been corrected to \$2.50 basis, which you are using in this case.

Questioned by Mr. Greene.

In deducting the pavement, I have taken the time on the men who did the work, and I knew the unit costs of opening the pavement, so that sheet 24 shows the cost of the trench work, and the removal of the surplus excavated material.

Questioned by Mr. Searls.

The cast-iron pipe in the high pressure system averages very much higher than the Spring Valley pipe. The minimum size of the pipe was 8 inches, and the minimum size of the main lines was 10 inches, therefore, there was considerable more surplus to be removed than in the case of the ordinary water pipe, so a deduction was made for the cost of hauling away the surplus excavated material, and on page 24a is given in the line ''Cost of excavation and backfill'', the cost of those items only, which is the cost from page 24, minus
7564 the cost of removing the surplus material. I think I assumed an average diameter of 14 inches. These figures on page 24a, cost of excavation and backfill, are too high to be used on domestic supply pipes, for a number of reasons.

1. The auxiliary water supply trenches average about 5½ feet in depth, while the Spring Valley trenches average only about 3½ feet; the labor cost of removing the materials from the deeper trenches, of course averages higher than the labor cost of removing from shallower trenches.

2. On account of the necessity for straight grades, and the requirement that joints be left exposed until after a satisfactory test was made, the auxiliary water supply trenches were left open on
7565 the average 10 days or two weeks, in some cases much longer, while the water company's trenches, I understand, are often backfilled the same day that they are dug, and rarely left open more than 2 or 3 days, or a week at the most. This means a greater expense for bridges and barricades, and more chance for caving of the sides of the trenches in the auxiliary water supply work. Also a greater expense for lagging trench, since the auxiliary water supply trench in sand generally had to be lagged, whereas, the Spring Valley Water Co.'s shallower trenches in sand would generally stand with little or no lagging long enough to lay and caulk the pipe, if the sand was wet, or contained a little loam or clay, which would hold it together. The

labor cost of lagging is included in the cost data on the auxiliary water supply trenches.

3. In the lowest portions of the city, considerable water was encountered in the auxiliary water supply trenches. The cost of pumping or bailing out the water is included in the cost figures for excavation. This expense would be very rarely necessary in the Spring Valley Water Co.'s shallower trenches.

4. The auxiliary water supply pipe frequently encountered brick or concrete sewers, in which, when it was possible to do so without interfering with the flow in the sewers, and necessary to do so to get the pipe down to the proper grade, holes were opened. This expense of cutting into sewers was included in the excavation cost. This sometimes occurs with Spring Valley Water Co. pipe also, but much less often than was the case on the auxiliary water supply system work.

5. The Auxiliary water supply pipe was often laid close to the curbs, so that care had to be taken to prevent the curbing from falling into the trench, and if it did fall in, it necessitated some expense to pull the heavy stone out of the trench. The Spring Valley Water Co.'s pipe is nearly always several feet out from the curb.

As a result of a discussion of these conditions, between Mr. 7566
Dockweiler and myself, the figures shown on 24a, as the adopted figures, were arrived at. These adopted figures were set by Mr. Dockweiler, and personally I would probably have reduced them a little more than he was willing to.

Questioned by Master.

There is one case where the figure is a little bit larger; on the last line the cost is given at 43 cents, and he adopted a figure of 60 cents. That was an isolated job out in the Richmond District. Taking District 2, those are simply round figures.

DIRECT EXAMINATION BY MR. SEARLS.

Mr. Stocker: The adopted figures from page 24a were then converted into cost of excavation and backfill per lineal foot, as shown by page 36. This adopted figure on 24-a, which is carried on finally to the seventh column of page 36, is independent of any removal of surplus material, and a surplus charge is added for that on page 36, columns 9, 10 and 11. Columns 3, 4, 5 and 6 take care of the lagging. Column 6 shows an average volume of trench lagged and 7567
unlagged. This average was taken so as to avoid a great multiplicity of computations. We obtained in that manner the total labor and team costs of excavation fill, and surplus per lineal foot, excluding the cost of lumber for lagging, but including the cost of labor required for lagging. The lumber cost is shown in columns 13 and 14.

On page 37 is a figure given for other soils than sand which do

Stocker

not require lagging. The figures from pages 36 and 37 are carried forward and added in; the labor figures appear in column 6, at pages 116, 116-a and 116-b. The percentage for profits, tools, superintendence, etc., is composed of two items, based on my own experience on the high pressure system of the auxiliary water system, 10% is added to the labor cost to cover the item of superintendence on the job; that is the general foreman, who could not be charged to any particular subdivision of the job, the timekeepers, watchman, and services of that kind, and the sharpening, repairing, and depreciation of tools and equipment. This made 110% of the labor cost, and to that was added a charge of 25% for general overhead expense and profit, which were fixed by Mr. Dockweiler, making a
7568 total of 110%, plus 25% of 110%, or making 137½%. Then on page 116 you get for the first district the cost of the trenching in column 11 for each of the sizes of riveted pipe. I had nothing to do further with the preparation of the estimates of riveted pipe.

7569 Questioned by Master.

These were figures for trenching as regards cast-iron pipe, with the exception that on this sheet 36 an extra allowance was made for the removal of the surplus excavated material from the deeper trenches for the wrought iron pipe, but the units were derived from the same basis as the cast-iron pipe.

Mr. Elliott: I mean that that 32″ covering was for riveted pipe and cast-iron pipe, and all sorts of pipe that we have in the system; that 32 inch was measured on. I have just made a calculation, and find that the average depth of the riveted pipes in San Francisco is exactly 5 feet; that is the average bottom of the trench is 5 feet from the surface.

Dockweiler Witness: J. H. Dockweiler for Defendants.

7570 DIRECT EXAMINATION BY MR. SEARLS.

These tables which were introduced this morning as 100JJ, and referring to the sheets that have been placed in evidence as "Exhibit "100, 100-a, 100-b, and 100-j," show the method I used in getting at the cost of making, transporting, dipping, laying and riveting in the trench the wrought iron pipe that was laid in the City and County of San Francisco. The sheet marked "Exhibit 100-a" shows the cost of the pipe delivered at the trench undipped. I have applied the same units there that I did for the country pipe, as far as the base costs, and fabricated costs, and laying costs as such are concerned, with the exception that wherever there is a specific kind of a joint noted, I have made a difference and allowed for such joint.

Taking "Exhibit 100-j", sheet 109-c and 109-d, those sheets show the cost of laying this pipe in the trench in the city, and are sep-
7571 arated according to riveted joints and lead joints. The various

difficulties which exist, particularly in Districts 1 and 2, with respect to getting the pipe to the trench, and laying it and riveting it, is set forth on sheets 116, 116-a and 116-b. I took my cost of laying the pipe, as shown on this sheet, from the sheets numbered 109-c and 109-d. It is shown on page 36. That page takes care of the trench costs only. The difficulties of laying the pipe in the city streets are included and taken care of in your trench work; there is 7572
a different unit of cost for excavation and backfill for each district. Mr. Greene was essentially correct in asking me whether the cost of riveting and laying the pipe were on practically the same basis as my costs in the country.

I have taken 37½% for field overhead, both city and country.

The depth of the trench excavated is evidenced in the unit of volumes of excavation per lineal foot of pipe. There is more yardage per lineal foot of riveted pipe, as they are so much larger than the cast-iron pipe. That difference is taken care of in the increased amount of yardage excavated, due to the greater depth of the pipe. The average depth of trench for the cast-iron pipe in the city is about 3½ feet. On the riveted pipes I have made no direct average computation, but I should say that the statement made by Mr. Elliott is substantially correct. I have estimated the depth of trench, 7573
and the quantity of yardage in excavation for each size pipe. In getting at my unit price per cubic yard, I made certain deductions on the high pressure costs. due to the assumed greater difficulty of excavating a deep trench for that high pressure pipe, as compared with the shallow trench for the cast-iron pipe. The unit prices for the Spring Valley riveted pipe should be loaded with the same extra cost which would be involved in the City high pressure pipe if you were considering the wrought iron pipes alone, but the way I have computed it, taking an average, I say no. Taking all the riveted pipe within the city limits, their total length of trench is very small in comparison to the entire amount of pipe mileage of all classes of pipe, so that my price is an average for all. If I were figuring on wrought iron alone, and excluding the others, then my units would have to be loaded with the amount that was deducted from it to get an average. I have taken the average conditions of both wrought iron and cast-iron pipes in giving this unit price per yard. I attempted to determine a unit for the excavations in the three districts at the time I made the estimate. Mr. Stocker's notes and data were available, and the deductions which he made, I employed, raising however, and fixing what I call my adopted figure per unit, using my own judgment as to what that should be. In other words, 7574
the prices for each class of material varied in the three districts.

Taking sheets 116, and 116-a, b and c, I took Mr. Stocker's figures, made in conference with me, up to column 11 of those sheets, with this difference, that what I called "profit, tools and superin-

"tendence, etc., 37½%", 10% of that 37½% was based upon information and experience had by him in the high pressure fire system construction, while the remainder, or 27½%, is based upon my judgment in the matter. The remaining columns in that table are taken by taking the cost of my pipe in the trench laid, and adding it to the trench cost, and getting my total cost, which I used in the inventory and appraisal I filed here.

Stocker Witness: LESLIE W. STOCKER for Defendants.

CROSS EXAMINATION BY MR. GREENE.

7575 Mr. Hazen: These are the eight contracts for pipe laying for the City high pressure work.

Contract No. 46, April 24, 1911, Michael Murphy:

For laying 6-inch pipe, $1.00 per foot;
For laying 8-inch pipe, 75 cents per foot;
For laying 12-inch pipe, 52 cents per foot;
For Excavation, $1.00 per cu. yd.

I understand that the price for pipe laying does not include the pipe or the specials, or the gates or the lead.

Contract No. 50, September 13, 1911, Michael Murphy:

For laying 6-inch pipe, 40 cents;
For laying 8-inch pipe, 50 cents;
For laying 10-inch pipe, 70 cents;
For laying 12-inch pipe, 70 cents;
For laying 16-inch pipe, 80 cents;
7576 For laying 20-inch pipe, 80 cents;
For excavation, $1.42½ per cu. yd.

I understand it does not include pavement work, but it does include disposal of surplus.

Mr. Stocker: The cutting open of the pavement was in all cases included in the excavation bid; the replacing of the pavement was a separate bid.

Mr. Hazen: Mr. Stocker may be right that cutting the pavement was included in the contract, but not the relaying; I assume that he is.

Contract No. 48, October 9, 1911, The Coast Improvement Co.:

For laying 6-inch pipe, 60 cents;
For laying 8-inch pipe, 60 cents;
For laying 12-inch pipe, 70 cents;
For laying 16-inch pipe, 75 cents;
For excavating, $1.30.

That contract was carried out.

Contract No. 44, February, 1912; Robert C. Storey & Co.

Laying 6-inch pipe, $1.00;
Laying 8-inch pipe, 80 cents;
Laying 10-inch pipe, 80 cents;
Laying 12-inch pipe, 40 cents; 7577
Laying 16-inch pipe, 90 cents;
Excavation, $1.40.

That was carried out.

Contract No. 44, July 8, 1910, Keystone Construction Co.:

Laying 6-inch pipe, 12 cents;
Laying 8-inch pipe, 20 cents;
Laying 10-inch pipe, 25 cents;
Laying 12-inch pipe, 40 cents;
Laying 16-inch pipe, 70 cents;
Excavation, 88 cents.

I understand that the contractor failed to execute that contract.

Mr. Stocker: That is right.

Mr. Hazen: Contract No. 47, July 29, 1910, The Raisch Improvement Co.:

Laying 6-inch pipe, 15 cents;
Laying 8-inch pipe, 22 cents;
Laying 10-inch pipe, 29 cents;
Laying 20-inch pipe, 92 cents;
Excavation, $1.03 per cu. yard.

That was carried out.

Contract No. 48, August 12, 1910, Oscar F. Levy:

Laying 6-inch pipe, 15 cents;
Laying 8-inch pipe, 20 cents;
Laying 12-inch pipe, 30 cents;
Laying 16-inch pipe, 40 cents;
For excavation, 80 cents.

The contractor failed to carry this out.

Mr. Stocker: That is correct.

Mr. Hazen: Contract No. 50, September 12, 1912, Foster & Voght:

Laying 6-inch pipe, 15 cents; 7578
Laying 8-inch pipe, 18 cents;
Laying 10-inch pipe, 22 cents;
Laying 12-inch pipe, 27 cents;
Laying 16-inch pipe, 38 cents;
Laying 20-inch pipe, 52 cents;
For excavation, 95 cents per cu. yard.

The contractor failed to carry this out.

Mr. Stocker: That is correct.

Mr. Hazen: As I understand they included the whole of District No. 1, the greater part of District No. 2, and little if any of District No. 3.

Mr. Stocker: The specifications in these contracts in the case of
7579 plain concrete called for a 1 to 5 mix of cement and rock, with sand to fill the voids. The water-tight concrete was the same, with an addition of some water-tight compound; the Medusa Compound was generally used, I believe; either that or hydrated lime. The concrete was used in the valve-vaults, and in the repairs of the sewers which I mentioned this morning as having been cut into. That was practically all reinforced concrete, and the reinforcement was paid for separately.

Mr. Hazen: I won't read all of the prices; the average on ordinary concrete on the three contracts that failed was \$10; on the five that were carried out it was \$16.40. For water-tight concrete they were respectively \$11.50 and \$20.

Mr. Stocker: The reinforcing element was paid for separately.
7580 It is customary to put the cost of reinforcing in; that is to say, if the reinforcing bar costs $1\frac{1}{2}$ cents a lb., it is customary for the contractor to receive $2\frac{1}{2}$ or 3 or more cents per lb. for it.

Mr. Hazen: I do not think that repairing a small cut in a sewer, with a very light thin wall, or putting a little concrete in a valve box, is directly comparable to the concrete work on the distributing reservoirs, but it has a slight bearing, in that these prices that were bid, and paid for contract work along the line. It is comparable to some of the concrete work that would have to be done in the Spring Valley system in reproducing it. There are lots of odds and ends that are included in the yardage of these schedules that have been estimated, and I think that in a general way this work is comparable to a great many of those small items to which we have paid very little attention. It is like the concrete in trenches that I in-
7581 cluded in my percentage for specials.

Mr. Stocker: These concrete jobs were all very small, ranging from 1 or 2 cu. ft., up to a maximum of 5 cu. yds. in the valve vaults. The average was probably not over 1 cu. yd. for a single piece of concrete work.

(The testimony, as just given by Mr. Hazen, is to be understood as correct, unless Counsel for Defendants finds some error in it in checking it.)

7583 Portions of the specifications covering this work were then read, as follows:

The following extracts are taken from specifications No. 8,807, contract No. 41, for hauling and laying cast-iron high pressure mains, etc., prepared by Mr. M. M. O'Shaughnessy, City Engineer, are instructive:

"He shall brace and support and pump and drain said excavations."

"Wherever additional information regarding the location of existing sub-surface structures may be required, the contractor shall excavate test pits at such points."

"The material excavated shall be placed in such a position as not to impede unnecessarily the general travel on the streets. One side of the excavation shall be left entirely clear to facilitate the hauling of materials and appliances to be placed therein."

"It will be the contractor's privilege to remove from the work and dispose of as he wishes all of the excavated material in excess of that required to refill the trench to official street grades."

"Where any crosswalk is cut by the trench, the contractor shall construct a timber bridge of sufficient width. Where in the opinion of the City Engineer it is necessary to construct a bridge for wagons, the contractor shall build and maintain same. Where the excavation crosses a wagon entrance to private property, a suitable bridge shall be constructed by the contractor."

"The contractor shall include the cost of the labor and materials necessary to perform the above work in the amount he bids."

"The pavement shall not be removed more than 100 feet in advance of the earth excavation, and the work of cleaning up materials, and the placing of temporary pavement shall be kept within
50 feet of the open trench. The total length of trench in any street 7584
over which the pavement is not in place, shall not exceed 500 feet."

"The contractor shall furnish, put in place and maintain such sheet piling, lagging and bracing, etc., as will be required to support the sides of the excavation and prevent any movement which could in any way injure the proposed work or any other structures."

"All sheet piling and lagging shall be cut where directed, and the upper part withdrawn."

"All vacancies left by the removal of sheet piling or lagging shall be carefully refilled with approved material, compacted into place by ramming with suitable tools, or by saturation with water as ordered by the City Engineer."

"The contractor shall remove any water or sewage which may be found or may accumulate in the trenches."

"The contractor shall provide in a manner approved by the City Engineer for the flow of all sewers and gutters interrupted during the progress of the work, and shall immediately remove all offensive matter as directed."

"BACKFILLING

"Fine sand, free from rock, shall be carefully deposited in the excavations so as not to disturb the work, and it shall be solidly rammed in layers not to exceed 6 inches in thickness until covered

to a depth of at least 1 foot. The trench shall then be filled with a material satisfactory to the City Engineer in layers not exceeding 6 inches in depth, each layer being thoroughly tamped, 2 tampers to 1 shoveler being employed. When so ordered, the fill is to be settled with water, which is to be done as follows:

"The earth is to be deposited in horizontal layers, one (1) foot in thickness, and flooded with water until, after standing for five
7585 (5) minutes, water will show on the surface, then another one (1) foot layer is to be filled and flooded as before. This filling shall be continued up to within one (1) foot of the surface of the grade at which a conduit is to be laid, and be allowed to stand for a few hours, or until the conduit is in place. The remainder shall then be put in and tamped as before specified. The contractor will be required to furnish any extra sand or other material satisfactory to the Board of Public Works, that may be required to refill the excavation."

"The contractor shall include the cost of the labor, and materials necessary to furnish and place the above extra material in the price he bids."

"PAVEMENTS TO BE TEMPORARILY PLACED:

"Immediately after the excavations have been refilled, the paving shall be temporarily replaced by the contractor, and maintained in such condition that traffic may be safely carried on over same, the excess material removed and the street cleaned. Material, satisfactory to the City Engineer, obtained from the existing pavements, may be used for temporary paving. However, in case there is not sufficient material, the contractor shall be required to furnish suitable planks, not less than four (4) inches in thickness, or satisfactory basalt blocks, to complete the temporary pavement."

"NOT TO INTERFERE WITH GAS AND WATER COMPANIES: The contractor shall not cause any hindrance to or interfere with any water, gas, telephone, electric light or power company or companies, railroad company or companies, or individuals having underground structures, in protecting their pipes, or otherwise removing and protecting their lines, conduits, or mains and service pipes, railroads, or any of their appurtenances, but the contractor
7586 shall suffer the said company or companies to take all such measures as they may deem necessary for the purpose aforesaid."

"PRICE FOR EXCAVATION AND BACKFILLING TO INCLUDE: The price bid shall include all of the labor, materials, tools, appliances and machinery necessary to remove the pavements, curbs, and sidewalks, to make the necessary excavations, to support subsurface structures, to sheet, pile and brace the excavations where required, to bail or pump out the excavations when necessary, to protect the excavations until they are filled, to backfill the excavations, to compact the same thoroughly, to remove the sheeting, to grade the

trench, to replace the pavement temporarily, sprinkle the excavations, to reset the curbs, to handle and care for all the materials excavated, to dispose of all surplus materials and clean up the streets. It shall also include the excavating or removal from the trench, and disposing of all existing crib work, sheeting lumber, rip rap, abandoned pipe, conduit and all other materials not herein specifically classified, that may be ordered removed by the Board of Public Works."

Questioned by Mr. Greene. 7587

Mr. Stocker: The contractor was permitted to leave possibly between 500 or 1000 feet of his trench open for 2 or 3 weeks. There is a very wide variation in that. The specifications were not strictly enforced. I remember one time out on Market Street when there was 1700 feet of pipe waiting for a test, which means that all the bell-holes were uncovered. We exercise a great deal of latitude in enforcing that provision.

My comment this morning, in which I said the excavation for the Spring Valley pipe would be less arduous and expensive than for the city pipe, applies to cast-iron pipe. If Spring Valley trenches were 5 feet or 5½ feet in depth, the comments I make there would not be obviated as to all of them. My first comment here is that 7588
the auxiliary water supply trenches averaged about 5½ feet in depth; the Spring Valley trenches average only about 3½ feet. Of course, if I assume that the Spring Valley trenches actually averaged between 5 and 5½ feet for riveted pipe, in that case this comment would have no force. The surplus haul is considered entirely separate.

On account of the necessity for straight grades, and the requirements that joints be left exposed until after a satisfactory test was made, the auxiliary water supply trenches were left open on the average 10 days or 2 weeks. I have not had much experience in the riveted pipe construction, but I believe the same thing would hold true of riveted pipe.

Mr. Elliott: We keep our trenches open sufficiently to test the 7589
joints. Sometimes it might be 2 weeks, and sometimes it might be only a few days. We test it by putting on a bump-head and turning the water on. I think that it would take as long to test a pipe subjected to the pressure to which the Spring Valley pipes are subjected, as it would to test a pipe thoroughly for the high pressure, because the character of the work is in proportion to what you would expect of it; the percentage of blowouts, etc., would be the same on a low pressure pipe as on a high pressure. You endeavor to make your joint tight whether it is for 100 lbs. or for 300 lbs.

Mr. Stocker: I have seen a little of the Spring Valley work in connection with cast-iron gas pipe work, and it is my impression that

the testing is not anywhere near as difficult or as long a job as it was on the high pressure system. I saw cast-iron pipe from 4 to 24
7590 inches in size. I remember a 24-inch main which was laid on Howard Street in 1905 by the Spring Valley Water Co. which was not tested at all.

Mr. Elliott: In the comparison of time you have in mind cast-iron; in testing a cast-iron pipe you don't lose the time that you do in testing a wrought iron pipe. In a cast-iron pipe you have your gates occurring very frequently, whereas in a wrought iron pipe, which has a much greater diameter, you can very easily lose a couple of days, as far as the pipe laying is concerned, on account of putting on the bump-head, taking it off again, and filling up with water and emptying it. The cast-iron is the easier pipe to test on account of the frequency of the gates.

Mr. Stocker: On the high pressure we had considerable diffi-
7591 culty at times in preparing to test. Under our very heavy pressure, the maximum test pressure being 450 lbs. to the sq. inch, it was necessary to take great care to prevent the end of the pipe from blowing out; from shifting in the direction of the pressure. It was necessary to use heavy timbers. In some cases we put a hydraulic jack in to tighten the pipe against the pressure. There is a pressure against the gate, or plug, or whatever it is that is closing the end of the pipe, due to the pressure being forced in from the pump, and the lead joints are not strong enough to hold the adjacent joints from being blown out.

Referring to the other points which have come up for comparison: My third point was that in large portions of the city considerable water was encountered in the auxiliary water supply system in the trenches. The cost of pumping or bailing out the water is included in the cost figures for excavation. This expense would be very rarely necessary in the earlier Spring Valley trenches, although the riveted pipe trenches of the Spring Valley may average the same depth as our high pressure trenches, still the riveted pipes are practically all laid in districts which would not be subject to that difficulty, so that this comment applies equally to riveted and to cast-iron pipes of the Spring Valley Co. The high pressure pipes are laid in the district adjacent to the bay, and that is where the riveted pipes are not laid.

7592 The fourth point is this: The auxiliary water supply pipe encountered brick or concrete sewers frequently, in which, when it was possible to do so, without interfering with the flow in the sewers, and necessary to do so to get the pipe down to the proper grade, holes were opened. This expense of cutting into the sewers was included in the excavation cost. This sometimes occurred with Spring Valley Water Co. pipes, also, but much less often than was the case on the auxiliary water supply system work. That difficulty is probably as frequent

in the riveted pipe of the Spring Valley as it is in the high pressure pipe.

The fifth point is this: The auxiliary water supply pipe was often laid close to curb, so that care had to be taken to prevent the curbing from falling into the trench, and if it did fall in, it necessitated some expense to pull the heavy stone out of the trench. The Spring Valley Water Co.'s pipe is nearly always several feet out from the curb. I think that applies equally to the Spring Valley riveted and cast-iron pipe.

Mr. Elliott: We always try to keep our pipe 5 or 6 feet out from the curbstone, and I should say that 90% of it is in that position. I would like to state here that as a general rule the city forced all other 7593
utilities to move out of their way when they were laying this high pressure pipe. In our case, when we endeavored to lay a main in this district, we either had to pay the other utilities to move out of the way, or else pay an additnonal cost for going around them. 7594

Questioned by Mr. Greene.

Mr. Stocker: Referring to my estimate on paving; I had information and some personal knowledge which I had gathered myself out on the ground, as to the cost of opening the pavement, and I knew the average width of the high pressure system trenches, and therefore I was able to make a deduction for the opening of so many square feet of pavement per lineal foot of trench. In getting that figure, I took time on the men who were doing that work, opening pavement. I used a figure of 5 cents a square foot for opening the asphalt pavement, and 1 cent per square foot for opening basalt blocks or cobbles. The information I used was the statements of my colleagues and assist- 7595
ants in my office checking my own work. I have never had any experience in cutting pavements, except on the city work. I have taken cost data on the Spring Valley work, and on the work of the San Francisco Coke & Gas Co., under Mr. Dockweiler's direction, about 10 years ago. I was merely a visitor on the job. Aside from those instances, there was no work which I directed covering either the cost of excavation or the cutting of pavement. My experience is limited to what I have already referred to, but if I had been in charge of the work which I was watching there, the record would have been just the same. 7596

When I gave my inspectors' reports, I gave them on the re-letting contract 48, which Mr. Hazen read in evidence. This contract was originally let to Levy, who failed, and then to the Coast Improvement Company.

Witness: Geo. L. Dillman for Defendants. Dillman

CROSS EXAMINATION BY MR. GREENE.

As far as my metal costs and my costs for fabrication are concerned, I employed the same basis here that I did in the outside work,

7597 so that the only additional point to be covered here is the excavation
in the city distribution system, and such incidental additional inconveniences as may result from that kind of work. The principal thing to know in reaching a figure of this kind, and to assume in case you do not know it, is the character of the organization that is prosecuting the work. One superintendent will do it for very much less than another. Onerous and rigorous specifications can increase the cost of doing the work very materially; difference in management can increase the cost very materially. In all these figures I am assuming no onerous requirement, and a good organization, properly handled.

I have recently watched the opening of trenches in this city, and
7598 the difficulties encountered in their excavation. I have seen a great
deal of it in the many years that I have been about the city here, and while I have not prosecuted it, or been in charge of it, I think I have appreciated the difficulty, and I have tried to cover the difficulties in these figures. That is a difficult point in an appraisal of this sort, but the actual difficulties, by reasons of obstructions, made a good deal less difference in the cost of doing the work than the efficiency of the organization. There is no question but what you actually encounter physical difficulties, but one man will get around an obstruction at half the cost that another man will.

The trench that is open now on Market Street is next to the curb. I didn't attempt to examine costs or difficulties resulting from the work in that trench, except what I could see just from observation. I
7599 think I have seen some trenches opened where the obstructions are
more than they are there, but they are taking out an 8-inch pipe now and moving it there. I saw it this morning.

I have never laid a distributing system in the municipality with the amount of obstruction that there is here. I have laid a distributing system at Oakdale, and over here in Contra Costa, which would be comparable to District No. 3. The population of Oakdale is 1200 or
7600 1500 persons, I think. I have never, personally, supervised the loca-
tion of large pipes, or any pipes in streets having the obstruction that these downtown streets have here. I have had the supervision of the installation of a distributing system in small towns that were comparable with Oakdale, with very few obstructions. Oakdale has a sewer system, but I built it, and it didn't interfere with the water system at all.

Questioned by Mr. Searls.

Mr. Hazen: The population of Springfield is about 100,000. I laid two miles of distributing pipe in the City of Albany a few years ago, which is a city of about the same size as Springfield. I have had
7601 to do with pipes in a great many large cities, but they were not under
my personal supervision. The ones in Springfield were not; I designed the system, but they were built by the Water Department under my general supervision. I made the estimate, but it was made for a

great deal of work, it was done gradually out of income. The work, as carried out, varied from the work as laid out to such an extent that an exact comparison as to final costs with the estimate was not possible. The cost, taking it street by street, ran pretty close to our estimates on the outlying parts of the city, but in the central part of the city our figures were overrun.

Mr. Dillman: I built some extensions to a portion of the old cable railroad, in Portland, and had direct supervision of that, where we had to excavate about four feet in depth, and we could not deviate at all; we had to move what pipes we ran into in the way of sewers and water pipe. I think that experience is comparable to some of the obstructions here in San Francisco. Those were the extensions of an existing line, and where we met the serious obstructions was with the
extension down Alder Street, and an extension of a few blocks down 7602
toward the Union Depot. I did not have those costs in mind when I made my appraisal here.

Witness: J. H. Dockweiler for Defendants. Dockweiler

Questioned by Mr. Searls.

Clay Street Tank: I told one of the men to get quotations on that, and to dope it out, as I called it. I never looked at the notes until they were in front of me here. If I had, I certainly would have checked them up, and they never would have gotten into the inventory at that price.

CROSS EXAMINATION BY MR. GREENE.

That applies to about three of the tanks. The four cents that he got for the erection of the tank is too much.

As far as the riveted pipe in the city is concerned, I have taken 7603
the same costs which I took outside for the base costs of the metal, and I have taken the same cost of fabrication that I took outside, and also the cost of making it up in the trench. It varies simply as to the length of the joints, that is all. If the joints were shorter in the city than in the country, that is evidenced by just having to make so many more in a given length. That is the method I pursued. My cost for excavation includes the difficulties of construction, such as obstacles, and the cost of backfill. There is an element included there which allows for the cost of carting away the excess material. The timber is also included in that excavation and backfill charge; the cost of the material itself is simply listed.

Ten percent of my 37½% on Table 116 is intended to cover the general superintendent, foreman, blacksmith, repairing, service wagon, watchman, lanterns, etc., based upon Mr. Stocker's observation and cost records on one of their high pressure jobs. I accepted that, and

added to it 25% for profit and incidentals, which made a total of
7604 37½%. In other words, I took 25% of 110. That is not a figure that Mr. Stocker and I agreed upon. We agreed on working out the data which he had, and which he showed me. As to the adopted figure, that was the one that I took. He argued with me very strongly, and told me that my adopted figure was too high, but I told him that figure would have to stand as I fixed it.

Referring to page 24-a, under District No. 1; the adopted figure of 80 cents for excavation and backfill was adopted, taking it for average conditions, as against a trench which was 5½ feet deep, and one which was, say 3½ feet, taking an average condition; in other words, if the trench was about 5½ feet deep, 85 cents for excavation and backfill would be proper, but averaging it by and large, and considering all of the data which went to make up the 85 cents figure, I adopted 80 cents as my judgment. I used these high pressure system figures, as this was the best and most authoratative data of the cost of doing the work that would have to be done in reproducing the
7605 Spring Valley water system. If it had been $1, I should have used it. I relied entirely on the accuracy of this work in the high pressure system as the basis for my excavation units in Districts 1 and 2, and I moved it into the appraisal with modifications; take for instance, sand in District 3, it showed 43 cents, I adopted 60. If there were any errors in the computation which I was provided with here, it would necessarily mean that my appraisal, which I have handed in here, would be changed to that extent.

7609 Mr. Hazen: On page 319, Structure 3, Item 2, I made an error in the price that I put on that 30 x 5/16 riveted pipe; the price that I put opposite that item is too small. If you believe that it is less than other estimates, and less than I have estimated for corresponding pipe elsewhere, disregard it, because I simply made an error in that figure, and it is a little less than it ought to be. It should be more than that; I think in the neighborhood of $9 a foot. I think the total error was something like $10,000.

Hazen

Witnesses: ALLEN HAZEN for Plaintiff.

7610 Mr. Hazen: When an engineer makes an estimate of the cost of building, or the cost of reproducing a structure or a system, it is a common practice, after writing down the estimates that are made for the several items, to add a percentage at the end. There is not uniformity in custom as to what this percentage should include. It is a very common proceedure for one making an estimate for work to be constructed, when he goes over the estimate that has been made, to take into account in a general way the thoroughness of the estimate; by that I mean its completeness with reference to all the details, and the adequacy of all the prices, and to correct in a measure for

what is conceived to be the deficiency or surplus in the estimate by increasing or decreasing the percent added at the end. That accounts, oftentimes, for variations in the percentages that are made in estimates that are otherwise similar. Very commonly the percentage that has been added has been referred to as engineering and contingencies, and has been intended to cover the engineering and contingencies; contingencies have been understood to mean items omitted accidentally from the schedule, or any items that might overrun the estimated quantities, or unexpected difficulties of any kind that involve expenditures that are to be paid in the prosecution of the work. The allowance for contingencies in this case, I have intended to put in my unit prices throughout, to include them in the bulk of the schedules, so that there will be no contingencies left for the present to be added at the end. I have done that for a number of reasons: Among them,
that when work is done it is very difficult to separate the contingencies 7611
of a constructional nature from the rest of the construction; and as a matter of fact, they are not, and cannot be adequately separated.

They may be estimated in advance, but when the work is done, the contingencies become a part of the work, and the total record of costs includes them; and for the further reason that I have been able to get the records of the cost of engineering and of administration for the construction of a number of waterworks systems, and those figures seem to me applicable in this case. These figures are such that all the contingencies are, or must be arranged in classification in the construction costs. So that I think for this case it was best, and that was the plan that I adopted to reflect all the contingencies into the unit prices, and as I am not going to say anything about them further in the overhead, I thought it might be proper to say a few words in regard to contingencies, and their relations to the estimates that I have made for the various items.

As far as the estimates of the unit prices that I have used in this schedule are based upon, directly or indirectly, the records of completed work made up after all the bills are paid, the contingencies that were actually met in those pieces of work are reflected and included in the prices derived from them. To take a specific case, that would apply to the Central Reservoir discussion we had the other day, taking the figure that was reported as the cost of the finished work, and finding the yardage, and dividing the cost of the finished work by the yardage. All the contingencies that were met in that work are included in the unit price that is derived by that proceedure. On the other hand, as far as contract prices have been used, or quotations, and they have been used by all of us more or less, they ordin-
arily do not reflect contingencies, and some addition would approxi- 7612
mately be made to all unit prices so far as they were deduced from that kind of data. The additional that would have to be made to cover extra work of various kind, and unexpected losses that the contractor

would have to pay, would vary from perhaps 2 or 3 percent for the kinds of work that presented the least risk up to—well it is hard to set that upper limit, they might be very large, indeed, on one small part of the work, but taking it altogether, I should think that as far as our unit prices depend on the contract prices, unchecked by final records of the cost of the work, that an average addition of perhaps 3 to 5 percent should be made to cover contingencies. It has been my intention to have unit prices sufficient to cover that as far as they are derived from that kind of data.

I am explaining this in a little detail, because the practice has not been uniform in regard to these things; it has not been uniform in my own practice. I have made different additions in different cases, according to what I believed was fair under the circumstances. So, therefore, I want to define very clearly in this case just what I am doing, and just how I am doing it, and give the reasons for it as far as I can.

I have the record of the engineering and administration that was actually paid in the construction of a number of waterworks systems. Those records cover the payments that were made from the time that the work in general, terms were decided upon and authorized, and from the time that preparation of detailed plans for construction commenced. These records do not cover the costs that were incurred for work done prior to that time, and which may be called preliminary investigations; I have no adequate statistical basis for estimating what additions should be made for these preliminary investigations. It is
7613 a matter of my experience that something like four projects are considered, discussed, and estimated upon for one that is actually carried out. The ratio is not an exact one, but I think that some such ratio would be ordinarily found among other engineers. The question comes up as to whether the estimate for preliminary expenses should be limited to those incurred in investigating the source of supply and the works that are finally built, or whether the other sources and other works that are investigated and are not adopted should also be brought into the consideration. Obviously, as far as the other sources and other works are related to the works that are finally built, and as far as it was proper that knowledge in regard to them was desirable and wisely obtained in prosecuting the business, the expense of such investigations is reasonably a part of the cost of the works that are actually built. The amount that is sometimes spent on preliminary investigation is very large. For instance, before the construction of the New York water supply was commenced, from which water has recently entered New York City, there was a commission that investigated several sources of supply and made its recommendations, and it involved a direct cost of some $400,000. And preceeding that, again, was another investigation, which extended to various other matters, and involved a large expenditure. And then there were various ex-

penses of the city departments, and so forth, in connection with these matters. That is one illustration, but it is typical. Investigations must be made of a great variety of subjects, and frequently through a considerable period, before construction can wisely be undertaken. Rushing ahead with a project before it has been thoroughly investigated, and before all reasonably promising alternative arrangements have been considered, often results in the waste of money. I don't know any way of getting good, sound statistical basis for estimating the amount of preliminary expenses. It is my judgment in this case that an allowance of 1 percent might reasonably be made.

ONE HUNDRED AND FIFTH HEARING. FEBRUARY 28, 1916.

Witnesses: ALLEN HAZEN for Plaintiff.
LEONARD METCALF for Plaintiff.

A joint exhibit of inventories of stock on hand, which is the in- 7615
ventory upon which the City and Company have agreed for all the years in controversy in these consolidated suits, was introduced and marked "Plaintiff's and Defendant's Exhibit 154".

Witness: ALLEN HAZEN for Plaintiff. Hazen

DIRECT EXAMINATION BY MR. GREENE. 7616

The 1% which I estimated for preliminary expenses relates to the engineering investigations only; it does not include any allowance for promotion or organization. I have had no experience on promotion or organization of a company of this kind that enables me to make an estimate, and beyond bearing the fact in mind that there would be some expense incurred under this head, I have not attempted to make a specific estimate, or assign any percentage for those purposes. The allowance which I made for contingencies, under construction, relates to construction contingencies only. There are sometimes expenses incurred which are called contingencies, which are not construction, and as far as that is the case, they are yet to be dealt with.

(A calculation of the cost of the engineering and administration and interest during construction of four waterworks systems was introduced and marked "Plaintiff's Exhibit 155").

These relate to systems constructed by cities, or in one instance by a metropolitan water board, which is in reality the Department of the Commonwealth of Massachusetts. I have used this data because it was the best and most applicable that I had, and because I have no

corresponding data relating to privately owned waterworks systems. At least ¾ of all the large waterworks systems in the United States are now in public ownership. I have been employed by both companies and municipalities in preliminary work, and in the design and construction of works. The methods employed in handling the engineering of waterworks construction vary greatly, but they vary
7617 more between different municipalities and different companies than they do between companies as a class and between municipalities as a class. I am confining what I have to say to those cases where the work was done in my judgment properly, economically and well, and excluding all the cases where outside influences were strong, and limiting it in that way, it is my judgment that the engineering work and the construction work, as done for corporations, and as done for cities, is comparable. I do not know of any substantial difference in the methods or in the cost that would probably be involved, so I think this comparison of municipal works may fairly be applied. It may be necessary to keep some things in mind, and perhaps to make some small allowances, but generally, I think it is a fair basis, and it is the best one that is available to me.

That remark would apply to interest during construction, with this exception, that companies pay more for money than municipalities, and that the difference in the rate would have to be allowed for. There is a great deal of waterworks construction going on in the United States all the time. Business is not standardized, and there are several reasons for that; one is that the local differences are very great. A gas works in one city, or an electric light station, is in a general way, a good deal like a gas works or an electric light station in another city, but a source of water supply has to be got out of the natural resources that are available, and those differ in every city of the country, practically, from every other city. In one case the water supply is obtained from wells, in another place from rivers by filtration, and
7618 in another case, as in the Spring Valley system, from upland areas by impounding it in storage reservoirs, and the conditions in all sorts of ways vary so much that the business cannot be compared and standardized as other lines of engineering work are standardized. It further differs because the work of construction has not been under any centralized control. It has been almost entirely in the hands of local people; each municipality selects its own committee or commission to handle its business. There has been more co-operation among corporations because owners in one waterworks company have frequently been owners in another, but with that exception, the business has been handled by local people. Generally speaking, they prefer to employ local engineers, who necessarily have been men with that particular experience in the problems that they were called upon to solve, and, generally speaking, the waste in waterworks construction has been pretty large.

A great deal of the work done in the country has been done under indaequate or incompetent administration or supervisions, and the costs have been too high. In a general way I should say there has been too little skill in engineering, and that has very frequently resulted in bad designs that involve additional costs; it has results in use of poorer materials, for in almost all the materials of construction there is more than one grade, and sometimes a great many grades, and unless one is skillful, and knows what is wanted, and what can be secured, it often happens that the price is paid for the proper material, and a poorer material actually goes into the works. Then the effect of too little engineering is reflected in extra work and in extra contingencies; as the engineering is poorer the contingencies increase. Finally, it resolves in the failure to reach the desired result. It has occasionally 7619
happened, in American waterworks history that works have been built at large expense, and when they have been finished the works have failed to fulfill their purpose, and other works have been necessary to follow up and produce the desired results. So, the engineering business has not been standardized, and there is a very wide range in what has actually been done; there has been a wide range in the costs of engineering that have been actually incurred in different works, and to compare the costs of engineering as a percentage which actually has been paid on miscellaneous systems without knowing how well works were built, and how well they were carried out, does not mean very much to me.

The engineering of the Spring Valley system shows remarkable skill and continuity of purpose. The materials employed in construction have been good in quality, and have been very well arranged to give the maximum service. To illustrate, I think any engineer would find it a very puzzling problem to take 21,000 tons of iron and form it into a system of pipes that would bring over 40,000,000 gallons of water from the sources of the Spring Valley Water Co. into San Francisco, and deliver it year in and year out through a long series of years without important interruption by accident. It involves close, hard study, and if the problem were to be attempted by a great many good engineers, I am sure that many of them would find it necessary to use a good deal more material than is in this system to secure the desired result. The works have been built for long life. If they had not been, the supply could not be maintained with the works as they now stand; and further, they were built with reference to future use as well as 7620
present needs. It rarely happens that an old system like this is bound, where there is so little of the material now in use, that apparently will be discarded in the connection with the development of the city, to supply a larger population and increasing future needs.

The Spring Valley system is a great deal more valuable because the engineering has been carried out in this way, and it seems to me that the work in this system is fairly comparable to that that has

been done in some of the best Eastern systems of waterworks, for which I am presenting statistics in this exhibit. The undoubted fact that many waterworks have been built with less expense for engineering does not seem to me very important; in this connection, this statement is not quite complete, in that it includes nothing for preliminary expenses of any kind, and, also, it includes nothing for what I may call the treasurer's expense; that is to say, the cost of issuing the bonds, borrowing the money, keeping the accounts, and paying the money out as required, have been handled in each of these cases by some public officers, and the expenses that have been incurred in connection therewith, with some minor occasional exceptions, have not been charged to the work. I have put in the figures as I had them from the records, and as these figures were not included, they are not included in my totals. One of the difficulties of finding the cost of engineering and administration, is that works are ordinarily built by the same parties that are doing other business, and it is difficult to separate the accounts adequately; that is to say, in the ordinary course of building works by a city, the various public officers of the city have to contribute their services, and expenses were incurred, and those expenses to the city are not ordinarily charged up directly to the work.
7621 There is no way that the records can be examined to find out accurately what costs are involved on account of the works. The best that can be done is to do as Mr. Lippincott and I did for Los Angeles, to go through and make a separation, and that has to be done in general terms, because there is no adequate basis for all parts of it, and so the result is necessarily more or less unsatisfactory.

In three of these cases this uncertainty has been eliminated, because the works have been built by a separate board of commission, created for that purpose, and having no other duties, and spending money for no other purposes. The first two sheets in this exhibit are a summary placed at the beginning, and show all the figures resulting from this study; I will pass those and take up first the analysis of the expenditures of the Board of Water Supply of the City of New York to December 31, 1915, with especial reference to overhead.

The Board of Water Supply was created for the purpose of building these works. The works constitute a wholly new water supply system for the City of New York, including the source of supply in the mountains, the aqueducts and pipe taking it to the city distributing reservoirs, and the main distribution throughout the city, from Manhattan Island and Brooklyn, and as far as Staten Island. It does not include the minor cast iron pipes in the streets, but only the main lines.

The Board was created, in the first place, under an Act of the Legislature; three members were appointed, one nominated by the Chamber of Commerce in New York, one by the Manufacturer's Association, and one by the insurance interests, acting through one of

their organizations. The men so nominated were men of the highest character and ability, selected for their capacity to do work of this kind; and the engineer who was selected, J. Waldo Smith, had made 7622
his reputation as an engineer for the East Jersey Water Co., one of the largest privately owned water companies in the East, and he was selected because of his fitness and ability to handle work well and economically. I speak with confidence on that point, because I was consulted as to his selection.

The work has been carried out through a term of years since that time, and has been as well and economically administered as is reasonably possible, in my judgment, for a work of that kind to be carried out.

Mr. Smith has had a free hand in the selection of his assistants, and in the management of the work; and the men selected for the more important subordinate positions under him were men for the most part who had had recent experience in similar work on the Metropolitan Water Board of Boston, which is the second item in the list, although the work was done earlier.

This New York supply has been so far completed that the first water reached the city for use just before the first day of January of this year. The main parts of the construction are completed, although there is still a great deal of finishing up to be done. I went through these accounts last year with reference to finding out just what the overhead had actually been on this system, and in doing that, I used the actual disbursements up to January 1, 1915, and the estimated disbursements for the year 1915. I went through the accounts rather carefully, with the chief engineer, and with some of his assistants, and with the auditor, and arranged a distribution; recently, while I was in New York, by the co-operation of the auditor and the chief engineer, I was able to get all the figures to the first of January, 1916, and substituted them for the estimates, and the account has been revised in that way. So, it reflects the actual payments up to January 7623
1st last.

The actual disbursements, as they are summarized by the auditor, are on page 3; the total disbursements are $129,799,406. The cents I have omitted from the auditor's accounts, as being unimportant in this discussion. This is divided, and shows how much was spent for acquiring lands, for administration, for police and engineering.

It was necessary to organize a separate police force to maintain order in the various construction camps on the work. They did the work that would have been done by the city police, if the work had been done in the city, but it extended outside and involved an expenditure which the city police force could not handle, and so a separate police force was organized for this special work.

The figures on page 4 are derived from the report, with the aid of some separations, with the help of the auditor. The payments for

construction under contract amount to $98,456,000. I will omit the hundreds in the reading. The payments on account of agreements for construction, $3,595,000.

The only difference between an agreement and a contract, as classified, is that a contract is let at public letting, ordinarily to the lowest bidder, while an agreement is work done under a contract made without the formality of public letting; some of the agreements, the largest of them, for instance, was with the Ulster & Delaware Railroad; it was necessary to flood a good many miles of the railroad in connection with this work, and an agreement was made with the railroad to rebuild a stretch of track and do various other things, and that, of course, could not be advertised, and that is classified as an
7624 agreement, instead of a contract. There were others, but that was very much the largest one.

Then, the retained percentages of contractors amount to $2,591,-000. That represents work that had been done on the first of January, but had not yet been paid for; so that was added to the account.

Then I add work done by force account and included as engineering, about one and three-quarter million dollars; that was an approximate figure, but was a fairly close one. Wherever work was done by force account, the men were employed by the day, as was actually done in various cases where it was thought the work could be handled better in that way, the auditor charged that as an engineering; and as it was really construction, it is properly added here and deducted from the engineering, and I have done it in that way. That makes the total construction work completed, $99,393,000.

The engineering, however, relates to more than that. The work under contract and not yet completed amounts to $3,371,000, and a large part of the engineering on that work has been done; and under agreement, in the same way, $379,000, making the total construction work completed and under way $103,144,000.

Now, in addition to that the engineering work done includes about $500,000 that was separated by the auditor and was known with approximate definiteness, spent on the investigations of sources of supply not yet developed, and in work on plans of filters and other structures not yet under contract, and is taken as being equivalent in the aggregate to the complete engineering of work costing $5,000,000.

The $5,000,000 is my own estimate. The $500,000 is a separate approximation by the auditor. The $500,000 is the cost of engineering
7625 on work costing $5,000,000 and not yet begun; the work will cost a great deal more than $5,000,000, but I took the $5,000,000 as representing the additional amount of completed work on which the whole engineering would have been an equivalent amount. The work will cost several times $5,000,000. When the work is built, there will be more expenditures for engineering also, so that this $5,000,000 represents just the amount which in my opinion should cover the $500,000

worth of engineering. The engineering on page 3, as summarized in the account, by deducting this $1,750,000 for work done by force account, and also deducting $310,000 paid on taxes, and charged to engineering in the main classification, leaves $12,027,000 as the actual cost of the engineering to date, and the work covered, including the $5,000,000 estimated as corresponding to the work for which plans have been made, is $108,144,000. The engineering cost is 11.12% on that amount. The police expenditure I have reckoned on the amount of work actually constructed, leaving out the work to be constructed, and I have taken the figures $99,393,000 from the addition on the fifth line from the top; the police amounted to 2.18%.

The administration, costing $1,434,000 I took as applying to the whole construction, and also to the land, with the estimated amount for the work done on force account, a total of $113,861,000, amounting to 1.26%. The sum of these percentages is 14.56%, representing the engineering, police and administration cost of this work, but not including the preliminary expenses before the work was started, nor any expenses for the City Treasurer and Comptroller, with reference to 7626
handling money.

Interest during construction: I have separated that into two parts, one as relating to lands, and the other including construction and all other expenses. I have made this separation between land and construction for the New York work, because the account was in such a shape that it was possible to do it, and I thought it was interesting and helpful to do it, and also because the cost of land in this case was larger, relatively, than for the other supplies. I have not been able to make a corresponding separation in all cases with the others, or a corresponding separation in any case. These separations were all shown by the books. On page 6 is a summary of the total payments that have been made by this board since the beginning of business, showing total payments, the payments for land, taxes paid on the land, total payments on account of land, and total payments for everything except lands. That is used for a basis of calculating the interest during construction.

I next show the bonds that have been sold by years, with the rate of interest carried; the average rate of interest carried by the bonds is 4.15%, but that was not the figure that I used for the following calculation, because $11,682,000 of 3% bonds were taken by the sinking fund commissioners for various accounts. The 3% bonds were not salable at par at any time during the period covered by this work, and so I have excluded the 3% bonds in calculating the interest rate; 7627
the table is also incomplete in that I did not get the 1915 bond sales. I have the 1915 expenditures; as measured by the results of the public sales of city bonds within the period, which I secured, the average rate of interest has been approximately 4.30%, and that is the rate which I used in the further calculation.

On page 8 is a calculation of the interest during construction, and the payments each year separated into two parts, one for land, and the other for everything except land is taken from the table on page 6, and the procedure has been as follows: For the payments made during the year 1915, for everything but land, $6,495,000, I have added 2.15%, that is half a years interest, at the average rate of 4.30%; that is to say, I have assumed that the expenditures were made to average as of July 1st of each year, and that no interest was lost by having the money in advance at the time of expenditure, an assumption pretty closely in accordance with the facts of this particular case, and going into as much detail as I thought the business warranted.

For the year 1914, the expenditure is multiplied by 1.0653, which is 1½ years' interest at the same rate, and for the preceding year, 2½ years' interest, and so on, the interest being compounded as we go back. The expenditures multiplied by these factors produce a product which is what the payments with interest at that rate amount to the first of January, 1916, and this sum is 18.02% more than the payments; in other words, 18.02 is the interest on moneys spent on structures from the time that the money was spent until the first water from the plant was used. The factor is reckoned on
7628 the payments. For instance, every dollar spent in the year 1905 at 4.3%, compound interest, would amount to 1.555, on the first day of January, 1915, and for the next year, 1.491, and so on. The engineering and administration were 14.56% as previously computed, and the entire overhead is the product of 1.1802 times 1.1456, equaling 1.3520; that is, the total overhead is 35.20% for the structures up to the time that the first water is available. That means that my interest during construction on the structures was 18%, and the calculation for the payments for land made in the same way shows 22.44%. That, however, does not represent the whole interest on the land; it represents the interest on carrying the land after it was acquired and paid for by the city. It does not include the interest on the awards, where they have been made by the commissioners—that is, the commissioners who made the awards for the land—or included by them in their awards; that is included in the auditor's statement of the cost of the land.

The whole cost of the land is briefly summarized by this analysis which I have made. The amount of awards for land, including that land that was purchased—most of it was condemned—a small part
7629 purchased—was $10,740,000. There were also awards for indirect damages of $171,000. The expenses of acquiring the land, not including interest, as shown by the auditor's report, were $4,217,000, and the expenses in connection with the damage awards, were $267,000, making a total expense of $4,485,000; the sum of $15,396,000 was the expense of the land to the city, with the expense of acquiring it, but not including any interest. The city further paid on the awards

of commissioners, interest at the legal rate of 6% as part of the cost of the land, \$1,654,000, making the total actual payments for lands \$17,051,000. To that I add the administration pro-rata, which we obtained, 1.26%, or \$215,000, making the whole cost of the land, including administration, \$17,266,000. Then the cost of carrying the land after it was acquired, and until the works were put in service, as represented by taxes, \$260,000, and interest at 4.30%, \$3,884,000, making the total cost of land, with carrying charges, \$21,411,000.

On the following page is a summary showing how the percentages were reached from these figures which are reproduced on the first page. The expenses and administration amount to 43.08%, and the cost of carrying, including interest and taxes, was 37.15%, and the two taken together, 96.23%.

On page 11 is a statement in regard to corresponding expendi- 7630
tures of the Metropolitan Board at Boston. This board was created for the purpose of building a new water supply for Boston and surrounding communities. It acquired the land, built the dams and reservoirs, the aqueduct and pipes, the distributing reservoirs to 7631
carry water to Boston, and to distribute it to all the cities and water companies in the neighborhood of Boston that elected to take it. It involved the construction of about \$23,600,000. The work was begun in 1895, and was carried forward as rapidly as work of that kind can be usually carried. The amount of construction is, therefore, rather closely comparable to that involved in the Spring Valley system. This was a separate board, and building these works was the principal business of the board; the board was afterwards given some other duties, but they were so distinct that they made no difference in these accounts. During the earlier years it had no other business at all. The accounts were kept separately, and the business was distinct from any other public business, and there was no mixing of accounts. There is this difficulty in separating the accounts. The board, in addition to building these works, bought part of the completed works of the City of Boston, and some of the other cities, and the separation has to be made between the works which were purchased and those which were constructed; that I have attempted to do.

That segregation is also as shown by the books. By that I mean that a number of different structures were built, and some of the structures were put in service before others were completed, and that makes quite a difference in estimating interest during construction. The largest and most expensive structure in the system was the Wachusetts Reservoir; prior to its completion it was used to store a limited amount of water. I have entered in this statement the amounts of its capacity, which it held at different dates, and when 7632
I have taken it as going into service, I took it as going into service long before it was filled, but after it had been filled to such an extent

that I thought it was fair to consider it as fairly in service. In valuing reservoirs full of water, it is necessary to take into account not only the time required to build the reservoir, but the time required to fill it; that may be taken into account either in allowing interest during construction for a sufficient period for the reservoir to fill up sufficiently at least so that it can be put in regular operation, or else, if that is not done, the value of the water in the storage ought to be estimated separately and added. Most of the construction work on this system was finished in 1905, but some minor construction was done, and many bills were paid afterwards. The following calculation was made, showing the payments on account of the entire system to December, 1906, and an approximate classification with reference to the overhead. That calculation has been made for other dates, one 2 years later, showing the small bills that were paid afterwards, and it makes no material difference, as far as this purpose is concerned, which date is concerned; for simplicity I have selected the date that seemed to me the most representative; carrying it further would not make any important difference. There is not any sharp stopping point to a calculation of this kind. The main work is done, but there are minor things that are done afterwards over an indefinite period, in fact, right along, in a going system. It is not ever completed as a definite thing, and construction entirely stopped.

The table on page 12 shows the items from the sixth annual report, and they are added up with reference to construction, and
7633 to engineering and administration. This separation between construction and engineering and administration is not made in the sixth annual report, but I made it from these figures, and this table shows just what I did. In the first place, the administration all obviously goes to overhead and engineering, and the preliminary work—the preliminary work does not refer to the preliminary investigation that was done before the work was authorized; in other words, surveys were made, and estimates were made, and a report, and it was decided to build this source of water supply, and provisions were made, and all these bills were paid and charged off to something. Then this board commenced the work, and this shows what they paid, and what they charged as preliminary work—I don't know just what it was, but it was some early engineering, but not the engineering prior to the adoption of the project. There are also items for medical service, for traveling, for rent, for lumber and field buildings, representing for the most part, the materials used by the resident engineers in their various camps and offices in the field. Under Mr. Lippincott's system, that would be called indirect expenses. I split that in half there. The police service goes to overhead, also sanitary inspection of the camps, and damages in

connection with the work; that may be a doubtful item; I have classed it as overhead.

This work all was done by contract, and the contractors were responsible for the damages that they incurred, and this was for 7634
some damages for which the contractors were not responsible. The items not charged to either construction or overhead is an item for water rates for municipal and corporation work, which included work which was done in connection with railroads and municipalities, whose works were interfered with by the construction of this system; that item, possibly, might go into the construction account, or part of it, but I think in most cases the railroads or municipalities did the work that was needed, in a considerable measure at least, themselves, and were compensated for it, so that I have classified it in this way. Then the real estate and the damages to real estate not taken, and the payments for water rights, and for the purchase of existing works—the purchase of existing works related principally to a part of the Boston water supply which was taken at about the end of the period, and which had nothing to do with the construction, except as it appears in the total statement of work done by this board.

These segregations between construction and overhead are based on my judgment of the amounts applicable to each. I was connected with this work in its preliminary stages for some time, and was employed in a consulting capacity with reference to a number of features of it as it progressed, and I was quite familiar with the work during the whole time of its prosecution. The figures in the first column are taken directly from the sixth annual report, and represent all payments by the board to that time. The separation is my own. Taking the item of buildings, I could not separate that exactly to state the number of buildings that were devoted to one use or the other, or the proportionate cost of such buildings. 7635
That would have to be taken as an approximate separation, based on judgment. That judgment was one based on my general experience as much as any knowledge of this particular instance. The division does not seem to be made, but this amount of overhead, $2,744,000, on a construction of $16,496,000, produces the figure which is written at the beginning of the schedule, on the first page, amounting to 16.65%. The interest during construction I estimated in the same way. The average rate paid upon the bonds, taking into account the premium obtained on their sale, was 3.1%. This goes back to a period when interest rates were much lower than they have been in recent years.

That does not prove that the credit of Boston is any better than that of New York. The rates correspond closely for the same times, but the fact that the structures were put in service at different times makes quite a difference in the calculation. If it were all

carried through to the end of the period, the interest on construction would be much greater than it is if each of the main structures is figured as a separate entity until it was put in service and the results averaged. I have taken the latter method of calculation. On page 15 is calculated the interest during construction for the Wachusetts dam and reservoir, which was very much the largest part of the construction, costing $10,818,000; the construction, excluding the first year, which was preliminary, went from 1896 to 1906, a period of eleven years; but the heaviest payments were from 1900 to 1904; during 1905 and 1906 the main part of the work was done,
7636 and the reservoir was filling, partially, although it did not get filled by any means up to the end of the period. The interest during construction on this amounts to 15.3%. This, I understand, includes both land and structures, the land being a smaller proportion of the whole than in the New York structures, and it was not separated. For the Wachusetts aqueduct, a much smaller structure, and built in a shorter time, interest during construction amounted to only 2.6%; and on the Weston aqueduct to 4.02%. On page 14 I have summarized this, giving the amount of construction for the Wachusetts dam and reservoir, including land and the interest, and for the Wachusetts aqueduct and the Weston aqueduct, and then for the distribution system and all other construction I was not able to get a satisfactory detail schedule, and I roughly estimated that at 5%, and adding it in that way, the average interest during construction was 9.42%. If the interest is figured on the whole expenditures until the substantial completion of the system, it makes it something like 16 or 17%, but I did not do that.

I did not figure on just the structures, leaving out the land. The books show expenditures each year on the important division for land and structures, and you would not need to go back of the bills to make that separation, and I did not attempt to do that. I think the land was included for the Wachusetts and Weston aqueducts, although it is not so stated in my tables; I think it was always included, but the reason for the difference is that the dam and reser-
7637 voir was a much larger structure, and took a much longer time to build, and then there was the time for partial filling after the main construction was completed.

The three items with reference to the new Cincinnati water works begin on page 17. This work also was done by a special commission created for the purpose, and their accounts were kept separately from the general accounts of the municipality. I was not connected with this work in any way, although as a visitor I saw it frequently during construction, and knew very well those who had to do with it, and who managed it. It was an admirable piece of work, and upon its completion a book was issued describing the work and setting forth the payments that had been made, classified

in a very satisfactory way, and so I have used this as one of the things for comparison.

The book was issued by the city authorities. This construction was begun in 1897, at a time when prices of material and labor were low, but the bulk of the work was done after the increase in prices, about 1900. There was a little difference in time, when different parts of the work were put in service, but I took approximately the average time when the completed plant was ready; the difference in time of completion is not very wide in this case, and I do not think it worth while to make separate calculations. On page 18 is the statement of the expenses, taken directly from the summary in the final report, showing the total payments for construction, \$11,457,-000, and it shows how the construction is separated from the over-head. The engineering and general expenses of administration amounted to \$1,292,000, or 13.65% of the construction. If the land is included as part of the cost of construction, the percentage be-comes 12.72%, so that gives the range, if the land is excluded or in-
cluded; practically, I think that the administration, at least, and per- 7638
haps some of the other expenses would go to the land, but I have no means of separating them. The interest during construction I have computed in the same way. The work was all paid for by money received by the sale of bonds, and the schedules of the bonds sold is on page 20. I took the average rate of interest as 3¾%, which is an approximate figure. I did not go into as much detail in reaching the exact rate as in the other cases. The interest during construc-tion figured at this rate amounts to 15.24%; taking the land and structures together, without separating them, we have interest 15.24%, administration and engineering, 12.72%, or a total overhead of 29.90%. This also does not include the preliminary expenses, that is the expenses incurred prior to the authorization of the work, and I presume it does not include any allowance for the city treasurer and his expenses. The 15.24 is interest during construction; 12.72 is the engineering and administration on land and structures. If the land is excluded, the engineering and administration would be about 1% higher. I have no way of telling what difference it would make with the interest. The figure is 13.65 with the land excluded.
The last item is the Little River works of the City of Springfield. 7639
This statement is less complete with regard to administration. In fact, it does not include administration. This work was done by the regular board of water commissioners of the city of Springfield, and the expenses of the board in supervising it and the services of the other city officers and so forth are not reflected in any way in this estimate, and it is incomplete to that extent; it includes the direct payments for construction up to the first of January, 1911, and the expenses for engineering and for some other matters that perhaps might be called contingencies that were paid, and that the engi-

neering department certified and knew about. The total costs of construction of structures was $1,513,000; that does not include the land. There were miscellaneous expenses of $25,648, engineering expenses, including the camps and table supplies, etc., of $172,255, an item for engineering, and on water rights, which ought not be included here, because the payments for water rights were large, and that is incorrectly classified, but I think this was part of a bill, probably, the rest of which was charged in this account; it got into this account and has always stayed here, and it is necessary to keep it to make it check with the totals shown by the city books, but that really ought to be excluded; legislative hearings, $8,948, and legal services $9348, so that we have altogether, for miscellaneous expenses, 1.69%; for engineering, 11.39%, and for the legislative hearings and legal expenses, 1.22%, a total of 14.3 per cent.

That does not include the preliminary expenses, the preliminary engineering investigations, nor the general administration. As to the miscellaneous expenses, I had a list of some of the items that went into that; the secretary told me they were everything that was not otherwise classified, and they include such items as presenting
7640 the various matters requiring approval to the various state departments, to the War Department, with reference to navigable waters, to the county commissioners with reference to taxes, etc., to the selectmen of the various towns with respect to roads; they included printing reports and specifications, advertising, expenses of recording papers and stamps, and a great many expenses of that kind that were paid that were not thought to be engineering, and would ordinarily perhaps be called contingent expenses.

This includes some roads that were constructed, and it includes the maintenance of the roads during construction, which was part of the construction cost; it does not include any other maintenance. This miscellaneous expense does not include any road work; everything of that sort was classified as accessories, under one of the headings in the first table.

The miscellaneous expenses, under the heading "Six contracts" is covered by what I have said. For instance, these various expenses were charged in connection with the six principal parts of the work, if they were related to them, but if they were not related to one of these parts more than the other, they were put under the general account.

7641 Referring to the column under "Engineering", and "Water rights, legislative hearings", my statement as to water rights applies only to the $185. The legislative hearings were necessary, because some legislation was necessary to permit the work to proceed in the way that it was thought it ought to go, and there were expenses in connection with that, presenting evidence, employing counsel and doing various things, and the legal expenses related to the advice

on drawing the various contracts and legal papers in connection with the work. This does not include the cost of the land, or anything for water rights which were estimated to cost \$325,000; although this work was completed and has been in use a good many years, much of the litigation in regard to water rights is still pending, and nobody can tell what it will ultimately cost yet. As far as the water rights have been acquired and closed up, they have been on a basis not very different from my estimate, which came to a total of \$325,000 approximately. It may be interesting as showing that we have water rights in the East.

On the first page I have placed a summary of the figures which I reached in these several tables for administration and engineering, and have given a line of figures that do not vary very widely for these pieces of work; for instance, for the Board of Water Supply, a very large piece of work, we have 14.56 per cent; for the Metropolitan Water Board of Boston, 16.65%, that being a much smaller piece of work, and one comparable to the Spring Valley Construction in size; for the new Cincinnati Water Works construction, a still smaller system, 12.72%, and for the Little River work, a much smaller one, 14.3%. These figures are all deficient in not covering the preliminary expenses, and the expenses in the treasurer's office, and in the case of Springfield also general administration, and I have used in place, to cover the engineering and administration on the Spring Valley system, including the preliminary and all expenses, 7642
15%, a figure which I think is fully supported by this record.

For the interest during construction, the amount depends upon the size of the work, and we have for the New York supply 18%, for the Boston supply 9.4%, for the Cincinnati supply 15.24%, and for the Little River works 3½%. That figure is not deduced from the schedule; the 3½% was the approximate rate of interest paid on the money borrowed to build these works, and the construction ran through not quite three years; I have never had the figures in sufficient detail to compute exactly what the interest during construction would be, but it would be approximately one year's interest. The heaviest payments came in the second or third years of construction; the first year's payments were comparatively small, and so in this comparison I have written in one year's interest. That work was pushed very rapidly indeed; there was an emergency, a threatened shortage of water, and it was carried out under our direction with a very active, enterprising young man in direct care, Mr. Lockridge, and the whole business was completed on schedule time, in a very short time; so I think that is rather unusual; it was also put in service before it really ought to have been; it was put in service the first of January, and we had to shut it down later on, after we had filled up the reservoirs, to make some adjustments, and to do some work that it would have been much cheaper to have

done before it was ever put in service; but that was a secondary matter, because we kept the city from absolutely being out of water by using it before it was really fairly done; and any extra cost and trouble that grew out of that was unimportant in comparison with the main object.

On page 2 I have put these same figures with a further calcula-
7643 tion that I think helps in understanding them and applying them to this case. This table shows, after the engineering and administration, the interest rate for the several cases, and then the total actual interest, and then the average number of years for which interest was paid. This is not a strict calculation. The figure was obtained by dividing the actual interest by the interest rate, so that is an approximate figure. For the board of water supply of New York structures, interest was paid on the money 4.19 years; for the Boston structures, for 3.04 years; for the Cincinnati structures, 4.07 years, and for the Little River, 1 year, that being my own estimate. For the land of the board of water supply, 7.85 years. In computing this 7.85 years, I took into account 6% that was paid before the awards were made, and 4.3% which was paid afterwards, so that it is a combination figure. Then in the next line I have written approximately what the interest would be at a 6% rate, multiplying those figures by 6%, and showing what the payments would have been at that rate with reference to what a company borrowing money at 6% would have paid under corresponding conditions, and then the last line shows the result of the application of that figure to the cost of the structures and the engineering and administration in the first line. In other words, in the board of water supply of New York, if 6% had been paid on the money, the overhead would have been 43.37%, for the Boston work, 37.91%, for the Cincinnati water works, 40.20%; for the Little River works, 21.16%, and for the New York Board of Water Supply land, the increase would have been 110%; that is, it would have cost more than double what was first paid. For the Spring Valley structures, on thinking the matter over, it seemed to me that taking it right through a period of
7644 construction of five years after the preliminaries was as short as could be counted upon, and an average interest payment for a period of two years at 6%, making 12%, and that is the figure which I have used. So I have added to the estimate for my structures 15% for engineering and administration and 12% for interest during construction, and the 12% is reckoned on the 15% as well as the 100% in making the calculation. I adopted the 5-year unit as the 6% rate because I think that is as short a time as it would be reasonably possible to build this system, pushing the work as fast as it could possibly be pushed; in fact, I doubt if all of it could advantageously be built in so short a period, but taking into account the fact that some parts of it probably would be put in use before other parts

were finished, it seemed to me that it was a fair estimate to make in this case, and in view of these figures which I found from the works which I have examined, and in view of the magnitude of the structures here, a two years average interval for interest, in my judgment, is as short a one as could be assumed for the construction, even taking into account the idea that parts of the plant would be put in service before other parts were ready. I do not know that I can say much about the 6% rate of interest; that, of course, is an assumption on my part. I am not qualifying at this time as an expert on interest rates. It is a matter of judgment.

The compound figure on overhead is 28.8%. I applied it throughout the schedule. Some people make separations, put more on one structure than on another; it seems to me that is a matter of specu- 7645
lation. I have no basis for doing that, and it seemed to me safer to take the figures from experience representing the whole condition and to apply them in that way; obviously, the interest during construction would be much greater on some structures than others, but I have overlooked that, taking it right through.

Questioned by Mr. Searls. 7646

I do not think of any one item of construction here that is absolutely dominant, or a controlling factor in the length of time necessary to build that system.

I would assume, for instance, that when the Crystal Springs water was available that business might be started at a good deal less than the present rate of business without waiting for the Alameda water to be brought in, which would probably take a longer time; but I have not attempted to make a construction schedule of that kind. It is not an easy matter to lay your work out theoretically so that all the parts will be done just at the moment, when they are constructed. There are too many uncertainties in construction to make that plausible. It seems to me the basis of broad, general experience backed up by reliable statistics of this kind, is the proper way of getting at it, than substituting a schedule that one evolves out of his mind and is obviously pretty much speculative. I did not use any such schedule as a basis for my computation.

The Master: In making any remarks on the Minnesota Rate Case, I am not deciding what that case decided. If the case does decide that—and there is a possibility of argument on it—in determining rates you must find market value of land without overhead or interest, or severance damages, or the like, it is, of course, simply 7647
because the court decides that is the equitable basis upon which rates should be determined; it does not determine what even the Supreme Court could not determine, that there would not be overhead expense, interest and the like on the acquisition of lands for a water supply; it is perfectly obvious they must not be understood as saying that you would not have interest on the lands you bought or

overhead in acquiring them. Now, if they have determined that in a rate case you will take the market value and not include any overhead, it is just because they think that is the way it ought to be done. I have no question at all that if this plant were to be reproduced, you would have overhead while you were getting your land, including engineering, administration and interest. No one has any doubt about that.

Metcalf Witness: LEONARD METCALF for Plaintiff.

7649 DIRECT EXAMINATION BY MR. GREENE.

When I began work on this problem I had anticipated that I should make an estimate of the reproduction cost of the property, and at that time I gave consideration to the question of the overhead costs and the interest during construction charges, which may well be incurred during the reproduction of such works as these. I have
7650 the feeling that the two subjects, the consideration of the unit costs to be used, and the overhead and interest during construction charges are closely interdependent, and that the two must be considered collaterally. I can illustrate best perhaps by saying that the character of the preliminary studies, the thoroughness with which the studies are made for the construction of large works will have an important effect upon the contract figures which may be obtained under competitive bidding upon those plans. Also because the element of uncertainty on the part of the contractor who is bidding will be reduced to a minimum. Furthermore, the element of the time of construction enters very largely into a consideration of those unit costs, for if it is to be assumed that the work must be done under rush conditions, the cost may be substantially enhanced thereby.

I have assumed and I understand that Mr. Hazen assumed that the work would be carried on as to time allowance under such conditions as might lead to the cheapest ultimate cost of the work including not only the unit costs making up the basic cost of the structural plant, but also the overhead charges and interest during construction allowance, which might result or which ought to be added.

I assumed myself that there would be required a period of construction of six years, including the preliminary investigation, the studying of plans, the making of the necessary plans, the acquisition of the lands and the rights of way, and so on, and the final construction of the property.

I assumed, further, that practically the entire first year would be used in the studies which would be made, and that the construction during the first year would be small in amount and would increase as the work progressed; that the organization would be grad-
7651 ually built up to a point of maximum efficiency and that then the

most economical results would accrue if that organization were so disposed as to keep it at a normal size, so to speak; in other words, that the best work would result if the labor employed was not rapidly increased or decreased during that period of time but kept along at a certain normal level, for if the organization is dropped and has to be picked up again loss in efficiency results.

In this connection I had in mind certain records, details of which I can give you a little later on, of the actual periods of construction which have been consumed in the building of large public works. Perhaps it might be as well to discuss that at the present moment briefly. For instance, in the construction of the Cincinnati Water Works, the new supply referred to by Mr. Hazen, the period involved in the investigation and construction of that plant ran from the Fall of 1897 for a period of about 12 years, the construction cost involved being about eleven and a half million dollars, or in round numbers involving an expenditure on the average of about a million dollars a year. Of course, in certain years a greater amount than that was expended.

That was taken from Mr. Benzenburg's report to which Mr. Hazen referred. It was a report gotten out by him. He was the chief engineer of the works. It was published by the city, I believe, in 1909.

Similarly, the extension of the Columbus, Ohio, Water Works, that is, the building of their new sources of supply, began in 1898 and was completed in 1908. The active construction, however, did not begin until June, 1905, I believe, so that the active period may be said to have been but about three years and four months. The work involved, $1,334,000, approximately. The source of information there is from a paper written by John H. Gregory, the resident engineer on that work, published in the American Society of Civil Engineers proceedings, Volume 67, page 260. 7652

The extensions made to the New Bedford Water Works, Massachusetts, were undertaken in June, 1893—that is, the inception of the work dates back to that time, the construction was begun two years later and completed in April, 1898. The construction period there was three years, involving a cost similar to that of the Columbus work, $1,300,000, the data being taken from reports of the water board.

The new water works plant at New Orleans, Louisiana, where a new supply for the entire city was recently built by the city there having prior to this time been but a very small supply, furnishing water to but a small portion of the city and owned by private works, there was undertaken in 1900 the active construction, begun in May, 1905, and was completed at the end of the year 1913, practically, although there were some additional charges incurred in the following year; that work involved a total cost of nearly $9,000,000, in

round figures; the active construction involved a period of eight years and seven months; again, that was at the average rate of about \$1,000,000 a year. The data are taken from the official reports of the water department of New Orleans. It is water, sewer and drainage work, but they have a separate report on each branch of the service. The new works being built for Baltimore, Maryland,—the Gunpowder River supply and high service reservoir—are still under construction. The inception of the project dates back to the year 1904-
7653 1905—the beginning of construction to the year 1908 and the completion of the high service there in December, 1910. The cost of the high service was about \$600,000. The period of construction was nearly three years,—two years and ten months. For the Gunpowder River supply a loan of \$5,000,000 was made. The work was begun in 1912 and is not yet finished.

Similarly, the new construction work for bringing the Skaneatelos Lake Supply to Syracuse, New York, which involved a total construction cost of slightly over \$2,000,000, involving a construction period of two years and eleven months, outside of the investigation period. Data for this is to be found in an article in the transactions of The American Society of Civil Engineers, July, 1895. The source of the Baltimore data is the reports of the water board.

In the case of the New York additional water supply the expenditures have of course been at a more rapid rate, the work extending over very large areas, and embracing several very large structures upon which large organizations could be employed. Some idea however is given of the rate of activity of that work by the statement—I cannot remember now, when the first report came out, perhaps Mr. Hazen remembers when the first report of the commission that investigated that was made—the Merchants' Association Report,—do you remember the year when that was issued, Mr. Hazen?

Mr. Hazen: No, I could not trust my memory as to that. A. (continuing) I shall have to look that up and give you the details of it.

Mr. Dockweiler: You mean the New York water supply?

The Witness: Yes.

7654 Mr. Dockweiler: About 1900.

The Witness: About 1900, you think?

In the year 1907, after the organization had been fairly perfected and the work was well under way there was expended something over \$2,000,000. In the year 1908 there was expended four and a half million dollars. In the year 1909 there was expended \$11,000,000. In the year 1910 there was expended \$19,000,000. In the year 1911 there was expended \$26,000,000. In the year 1912 there was expended \$23,600,000. In the year 1913 there was expended a little over \$21,000,000. These figures are perhaps approximate. They were taken from the New York Water Supply reports. I can give them to you in

greater detail covering the various structures if you wish them. They are of significance principally in showing the time element required to build up an efficient organization to get work of large magnitude under way. That work has not yet of course been completed although it is nearing completion.

Those figures are comparable with my assumption that an active period of construction approaching five years—four and a half to five years—would be required to build these works. If it were assumed that a period of four and a half years were not taken, it would, in my judgment, increase the unit prices which have been allowed on these works, because the work would be done at a disadvantage, the organization would not be so perfect; the construction work would not be 7655
done under such efficient conditions growing out of the fact that the time element is very important in the developing of the best efficiency in construction. In making that statement, I include also consideration of the interest during construction allowance.

It is a fact that as a matter of judgment, reviewing the data which I had, and the experience which I had, I came to the conclusion that including the preliminary expenses of organization, incorporation and investigation, and so on, in the overhead costs and the taxes during construction, which would have to be paid up to the time that the several units of property went into service, an allowance of 15% was a fair one to cover the overhead costs. The question of the fair allowance for interest during construction I approached from two points of view: first, the general question of what seemed a fair allowance in view of experience elsewhere, and from what I had seen from the character of these works, and the conditions under which they would be built. From that point of view I arrived at the same figures that Mr. Hazen did, of two years period of time, which, at a rate of 6% would give 12%. In arriving at that figure, consideration was given to the length of time which would be required to build these works. I then investigated in somewhat greater detail such an order of pro- 7656
cedure as might be had in the building of the works and figured the costs approximately which might result as to the interest during construction allowance upon the theory that the various workable units of the plant would be put into revenue producing operation as soon as they could be so used. So that although I estimated that a six year period would be required for designing and building the works I assumed that their operation, or the operation of a portion of the property, would begin at the end of three years, and that operation and construction would be carried on collaterally during a period of three years, and that three years more thereafter, that is, after the completion of construction, would be required to develop the existing business of the company; that is, a period of six years of construction would be required, including the preliminary design, and a period of six years for the development of the business, there being an overlap

of three years in these two periods of time. It is of importance under certain methods of computation to bear in mind the assumptions with regard to the time when the various units go into service. If the assumption which I made carries, that is, if as soon as a workable unit can be put into service, it is assumed that it will produce revenue and that any deficiency in revenue thereafter until the plant as a whole is a successfully operating plant is taken care of in the development expense it makes little difference just where you draw the line between interest during construction and the interest incurred during the development period for in figuring the development expense later, I have made deduction for the interest during construction allowed in the
7658 interest during construction period. If, however, consideration is not given to this fact in the development expense and there is figured into the interest during construction allowance only the interest during construction incurred in each particular item or unit you will fail to allow for the interest payments involved in those various items or units of construction which have to be carried until they are put into operation. When, on the other hand, you review the actual conditions which have been met in the construction of other plants and figured there your interest during construction allowance this item is of course taken care of. Figuring on interest during construction upon this assumption in somewhat greater detail I found that upon a 6% rate of interest and the approximate construction costs taken which correspond with Mr. Hazen's findings, a total interest allowance of 11%; and upon a 7% rate 13.1%. And reviewing the various assumptions which I made and which one must make in such computations it seemed to me that an allowance of 12% interest during construction was a fair one. The 13.1% resulted from the assumption of a 7% rate of interest, and taking all of the other assumptions the same as when these figures were based upon a 6% rate of interest.

It might be well, perhaps, to consider in a general way the items, or the classes of cost which in my judgment generally enter into overhead costs of work of this sort, and with that in view, I have prepared a statement as follows:

(The following statement "Metcalf on overhead and interest during construction" offered in evidence and marked "Plaintiff's Exhibit 156".)

OVERHEAD COSTS.

7659 "In addition to the basic cost of building engineering structures, "there are always incurred incidental costs, which are generally classed "by engineers and public service commissions as "Overhead Costs".

"The nature of the segregation varies greatly on different works "and in different parts of the country.

"The ordinary basis used in the greater part of the United "States, excluding the States west of the Rocky Mountains, is to in-

"clude in the basic construction costs what might be termed the 'fair "contract cost' of the work, or such cost as would be involved by the "finished work under contract prices obtained after fair competitive "bidding upon uniform detailed specifications and plans, and then to "include in 'overhead costs' those additional costs which the corpora- "tion or the owner of the property may have to meet, independent of "the contract costs, although much work is done in the East, also, by "day labor, instead of by contract. In such a classification there will "be included in these overhead costs the following general groups of "items:

"1. Preliminary expense of incorporation and promotion.

"2. Engineering and superintendence expenses.

"3. Legal expenses.

"4. Administration expenses.

"5. General and miscellaneous expenses.

"6. Discount and cost of marketing securities.

"7. Contingencies, omissions, etc.

"8. In some cases, interest-during-construction cost, though the "latter is here, and ordinarily, accounted as an independent item of "expense.

"9. Taxes-during-construction, though this item is sometimes "accounted in the development expenses.

"In the far Western States, on the other hand, as a result the 7660
"fact that much of the heavier construction has been done by the cor- "porations or owners themselves, instead of by contract after com- "petive bidding, there has grown up another practice, that of includ- "ing in the 'basic costs' only the direct costs involved by the work, "and in the 'overhead costs' on the other hand not only the 7 or 9 "different classes of items cited above, but also what would otherwise "be the contractor's plant, construction, tools, machinery and equip- "ment, and the auxiliary or incidental construction costs, which in the "Eastern work are included in the basic fair-contract-costs. Thus, for "instance, in the recent construction of the Los Angeles Aqueduct, "there were accounted in the 'auxiliary and construction cost' items "covering surveys, general engineering, pipe lines (maintenance and "operation), telephones, roads, and trails, certain building expenses, "erecting low tension power lines used during the construction of the "works, division administration, miscellaneous tests, expended cement "sacks, patrol, miscellaneous losses, reorganization, concrete replace- "ments, equipment expenses, and there was charged to the overhead "expenses also the item of 'net debit on cement plant' amounting to "about $883,000, the city having undertaken to manufacture its own "cement for this work, in preference to buying cement at the market "prices then quoted by the cement mills.

"A brief reference may here be made advantageously to the dif- "ferent classes of items generally included in the 'overhead costs'.

"Preliminary Expenses, Organization, Incorporation and Pro-"motion: At the inception of any quasi-municpal or corporate pro-"ject, a general investigation must be made of the business possibili-"ties, the local and municipal conditions and environments. A pre-"liminary engineering report is made after examination of the local "situation. Legal advice is obtained. Options must be taken upon
7661 "properties necessary to the execution of the project; franchise and "other necessary rights obtained. Organization must then be per-"fected, incorporation papers prepared and filed, and the project must "be promoted in order to interest capital and make the necessary "financial arrangments.

"Engineering and Supervision: Then follows a more detailed "investigation by engineers and others, of the local situation and en-"gineering records, the making of borings and obtaining of necessary "data for intelligent planning and execution of the work. Detailed "construction plans must be made, specifications drawn, bids ob-"tained and accepted for the work or plans matured for the neces-"sary equipment and organization for the successful execution of the "work by day labor.

"Then follows the period of construction, involving inspection of "materials, general direction and supervision of the work, auditing, "accounting, making of estimates, comprehensive surveys, examina-"tion of deeds, plans for acquisition and condemnation of lands, em-"ployment of necessary agents, recording expenses, etc. The engineer-"ing and administrative problems incident to construction, and to the "limbering up of the plant with its operation during the weeks or "months prior to its actually rendering service to the public.

"Legal: Incidental to the preliminary investigation, incorpora-"tion of the company and obtaining of franchises and necessary rights
7662 "legal services are required, also with reference to the company min-"utes and records, contract provisions and forms; land appraisal, ac-"quisition and condemnation, examination and recording of titles and "mortgages; preparation of trust deeds or mortgages, with provisions "relating to receivership, sinking fund, allowances, etc.; the financial "problems involved; interpretation of contracts, bonuses and penalty "clauses, insurance and indemnity, etc.; damage suits and settlements, "injunctions, etc., and many other details of a legal nature, during the "construction and early operating period.

"Administration: Salaries and expenses of executive officers, "clerical assistants, purchasing, auditing and accounting, inspection, "testing, new business, and collection departments. Labor incident to "policing and sanitation, care of sources of supply and reservoirs, "pumping stations, conduits and distribution system during construc-"tion and limbering up period before the beginning of actual daily "service. General Expenses of all kinds, during the construction and

"early formative period,—rent, stationery, office equipment, telephone, "telegraph, transportation, advertisement and kindred expenses.

"Discount and Financial Costs incident to the opening of the "necessary capital, marketing of securities, etc.

"This item is, however, not included here and is often omitted "from the overhead costs, being separately accounted and considered, "as here, incidentally with the fair rate of return.

"A number of the State public utility commissions, such as that "of the State of New York, for instance, include the discount upon "bonds and kindred expenses in the cost of reproduction of the works, 7663
"instead of giving weight to this item in the consideration of the fair "rate of return to be allowed upon the property.

"Contingencies: These may be divided into two broad groups: "First, those incurred by the contractor or the builder of the works. "Second, those which have to be met by the corporation or the muni-"cipality for which the work is done.

"In the first class may be included costs involved by adverse "weather conditions—rain, snow and freezing—failure to properly "coordinate the work and to have materials and supplies on hand "when needed, due to accidents, injunctions and other proceedings, "all of which would tend to disorganize the forces or reduce the effi-"ciency of the organization; money market stringencies, strikes, short-"age of labor, changes in cost of labor, materials, supplies, etc., diffi-"culty in getting and holding competent men; and various additional "factors which cannot well be determined in advance of the work and "which may be unforseeable or unforseen; partial failures always in-"cident to the building of large works, necessary modifications of de-"sign and costs incident to the coordination of different parts of the "work, and costs growing out of various hazards.

"The second class covers those contingencies which the corpora-"tion may be called upon to meet and which vary greatly in different "places of construction. These expenses are often closely allied to "some of the classes of expenses previously alluded to, such as legal, "administrative and financial problems, some times being included in "one class, sometimes in the other.

"In the analysis of the reproduction cost of the works of the "Spring Valley Water Company those contingencies influencing di- 7664
"rectly the unit cost of the work which would be borne by the con-"tractor, or by the corporation if the work were done by day labor, "are assumed to have been accounted in the unit prices adopted. The "contingencies which would have to be met by the company, were the "work done by contract, growing out of its relations with the con-"tractor or of other causes, or which would have to be met by it were "it to execute the work itself, and which would not naturally be ac-"counted directly in the unit costs, are included in the overhead con-"tingencies.

"Taxes-during-construction. Upon any large works requiring a "long period of time for their construction, this item becomes one of "substantial importance, and should logically be accounted with the "overhead costs. It is, however, sometimes given consideration in the "computation of development expenses. It is desirable to account the "taxes-paid-during-construction with the overhead costs, and taxes- "paid-during-the-early-period-of-acquisition-of-business after the be- "ginning of operations in the development expenses. The taxes have "been thus accounted by Hazen and Metcalf.

"Record of Overhead Costs: In the following tabulation are "shown in summarized form, and thereafter in explanatory detail, the "overhead expenses actually incurred in the construction of a consid- "erable number of important engineering works of different kinds. "These records of overhead cost have been grouped under the follow- "ing heads:

"1. Administration, engineering and superintendence, miscel- "laneous, and total (excluding taxes, contingencies and interest) upon "39 different plants or pieces of construction."

The citations I have not included in this list.

"3. A brief statement of the more important data upon which
7665 "the summarized statement was based, containing the details of over- "head expenses, interest-during-construction costs, and cost-of-assem- "bling lands, from which the summarized sheets relating to these sub- "jects were prepared."

I did not include the second one, but I will add it:

"2. Citations of overhead costs allowed, in the valuation of "water works properties, by fifteen different boards of arbitrators or "boards of engineers, by agreement.

"The latter are of significance only as indicating the concensus of "the opinion of the arbitrators in the cases under review. Particular "attention is called in the latter record to the greater overhead al- "lowance upon the works of large magnitude growing out of the long "period of construction involved, and hence, the greater interest- "during-construction charges resulting."

"Comment on Overhead Records of Overhead Costs and Interest- "During-Construction: Particular attention is called to the records "of overhead and interest-during-construction costs involved in the "building of several of the more important water works plants in this
7666 "country, based upon the Eastern United States classification of over- "head costs, as comprising the costs which have to be met in addition "to the fair-contract-cost of the works, and not upon the Pacific Slope "practice of including in overhead cost the auxiliary construction "costs. In the examples cited the auxiliary construction costs are in- "cluded in the basic-fair-contract-cost of the works.

"The overhead cost upon the new Catskill water supply of the "city of New York (1905-1915) has involved overhead cost approxi-

"mately 14.56%, interest-during-construction cost and taxes at a rate "of 4.3% amounting to 18.0% (to be applied to the combined con- "tract and overhead cost) and a total combined overhead and in- "terest-during-construction cost of approximately 35.2% of fair con- "tract cost, figured on the structures only,—the corresponding "amounts upon the land being 43.08%, 37.15% and 96.23%.

"In the construction of the Metropolitan Water Works supply- "ing Boston, Mass., (1896-1906) and neighboring communities, the "overhead cost amounted to 16.65%, the interest-during-construction "at a rate of 3.10% amounted to 9.42%, and the total, based upon "the fair-contract cost to approximately 27.6%,—based upon the "combined cost of land and structures ($23,600,000)."

In the footnote I call attention to the fact that this 9.42% interest-during-construction item on the Boston work was figured by Mr. Hazen on a 3.10% annual rate base.

My analysis indicates nominal bond rates of 3½%, averaging 3.37% and with an allowance for the premium upon bonds, an actual annual rate of 3.16%. I might say that the reason for the difference between Mr. Hazen's 3.10 and my 3.16 I think grows out of the fact that he took into consideration that at the end of the life of the bond 7667
the municipality paid back but the face of the bond. I did not make allowance for the premiums in that way. I got my average rate including the premium but I did not take into consideration this amortization. On the other hand, as I view the situation, that is offset in a measure by the fact that the sums required for construction are usually borrowed some time in advance of the actual construction; therefore the municipality does not get an immediate return upon its borrowings; the funds lie idle and draw at most a small rate of interest in the bank. If the funds are handled by the municipality, as I believe they are in New York, so that funds may be used for any city purpose—at all events in such a way that the period between the borrowing and the application of the funds is very short, there would not be such offset. In Boston I believe the period is somewhat longer because the periods of borrowing are further apart. But the difference is not very material in either case. On a 3.5% basis Metcalf figures the interest during construction allowance at 16.8% instead of 9.4%, allowing interest upon the distribution pipe system until the entire completion of the plant, December 31, 1906, or if six months interest be allowed upon the distribution pipe system, and it be assumed that the pipe system comes into service promptly after being laid, then the amount would be 11.4% on the nominal 3.5% annual rate; or 10.3% on the rate of 3.16%. In other words, my figure which is comparable with Mr. Hazen's is 10.3% as against Mr. Hazen's 9.4, the difference between the figures being due to the facts cited.

"In the construction of the New Cincinnati, Ohio, (1897-1908) "water supply system, the overhead cost amounted to 12.72%, the

7668 "interest-during-construction to 15.24%; the combined total, based "upon the fair-contract-cost, to 29.90%,—all based upon the combined cost of land and structures ($11,000,000)."

I got that from the same sort of information that Mr. Hazen used.

"In the construction of the Little River Works of the City "of Springfield, Massachusetts, (1907-1908) involving a total cost "of about $2,000,000 for structures only, the overhead costs "amounted to 14.3%, the interest-during-construction at an annual "rate of 3.5% amounted to 3.5% and the total overhead and interest, "to 18.3%" all as stated by Mr. Hazen in his testimony this morning.

"All of these works are of large magnitude. It will be noted "that as the works decrease in size, the combined overhead and "interest-during-construction costs also decrease, being as low as "12% to 15% in small plants capable of construction during one "working season. There is to be noted further the effect of low "annual rate of interest reflecting the credit of the city."

And there might be added to that statement of fact that the amount of the land holdings have an important influence upon the amount of the interest during construction allowance for the reason that the lands can most advantageously be bought at the inception of the project, or very early in the period of construction, and if so bought they have to be carried for a longer period of time which result in a higher interest-during-construction allowance. This fact amongst others has the effect of increasing the interest during construction allowance as I see it upon the property of the Spring Valley
7669 Water Company inasmuch as here the lands constitute nearly one-half of the value of the property, whereas in our Eastern water works, with more abundant supply, our land values are less than 10% generally; in the smaller works not over 5 to 7% of the entire value of the property.

"Overhead allowance by Hazen and Metcalf in Spring Valley "Company Property, Reproduction Cost Estimates:—

"In estimating the reproduction cost of the physical property "of the Spring Valley Water Company, Hazen and Metcalf have "followed the Eastern practice, showing in their reproduction cost "schedule what are believed to be fair contract prices for doing the "work, and have then applied an allowance of 15% to cover over-"head costs, and to the sum thus found they have added 12% to "cover interest-during-construction. The sum of the overhead and "interest-during-construction allowance thus amount to 28.8% of the "estimated basic-fair-contract-cost of the physical plant."

There follow then tabulations, which perhaps should be rearranged as to order, giving citations of the overhead cost records which I have been able to obtain of a number of different works.

I may say in general, that these costs have been obtained from the official reports of the department; they represent, I believe, the financial costs of the works. I was not able to get segregation in all cases; in some cases the information is limited to one single line or item of overhead costs. I have given you the records which I have been able to assemble, I think all of the records, so far as I now remember for this purpose, and I may add that some of them were assembled, had been assembled in connection with the work of a committee of
the American Society of Civil Engineers on the valuation of public 7670
utilities. If you will turn first to the page which begins with the New York Water supply—I think it is No. 11—you will see that I give there the figures that were worked up by Mr. Hazen and which have been testified to by him this morning. There follow the figures upon the Metropolitan Water Works of Boston, which were submitted by Mr. Hazen, showing the total cost, excluding taxes and contingencies, with interest of 16.65%.

The next figure upon the engineering and superintendence cost was one that was worked up by Mr. Frederick P. Stearns, Chief Engineer of the Metropolitan Water Board.

The Weston Aqueduct figures were worked up by my office under my direction from the official records, some of the details of which I can give you.

Similarly figures were obtained upon the engineering and superintendence cost of other items of construction involved in the Metropolitan Water Board work.

I give those merely to give you some idea of the variation in engineering costs involved in the structures there shown of different character.

Then follows a record of the Cincinnati Water Works, which has been discussed in detail by Mr. Hazen; and a record of my own of the Cincinnati Water Works, based upon the cost, excluding real estate, overhead and interest charges, amounting to $9,279,000 approximately. It was taken from those same documents. I will go
back to some of my notes and see if I can locate them for you. I 7671
find that the Cincinnati data was taken from the report from the Board of Trustees, No. 1909—page 247. I have segregated the percentage without lands. The item of real estate and rights of way seems to be $273,771.

Mr. Hazen: I check you on that.

Mr. Metcalf: Then the other items included in the other costs given are construction, engineering and inspection, preliminary engineering and experimental plant, legal expense, office salaries, and administration expense. Eliminating the real estate item that I have
mentioned, and predicating the other costs upon the construction, ex- 7672
cluding the real estate, the percentage is 14; including the real

estate, and finding the percentage it is 13½%. If there were overhead costs, such as legal expenses and rights of way agents, and recording expenses in the acquisition of real estate, I included all of those in my overhead figures, and applied them to construction costs to get 14%. I cannot segregate those any more than Mr. Hazen could. If you base it, however, on the construction costs, including the real estate, it will be 13½% instead of 14%. That gives you a line on the extent of your error if you make that assumption. The total overhead on the total cost, including the land, we know. To the extent that it is true that you might have a very small amount of land purchased, and at the same time have a relatively large overhead, it would modify the figures given, but the amount of the real estate in the aggregate is not very large; it is about 3% on the construction cost, excluding all of these other items.

On the Pittsfield Waterworks, in Massachusetts, which covered a masonry dam, reservoir and pipe line on the additional supply recently built, the total engineering and superintendence cost amounted
7673 to 13.8%, as given in the Report of the Committee on Water Supply, Hiram Miller, Chief Engineer.

The Kennebec Water District supply to Waterville, Maine, supplying Waterville, Winslow, Fairfield and Benton and China Lake also was executed under my own supervision, and I obtained those records from the cost records, there being given here only administration, engineering and superintendence costs; the miscellaneous item I was unable to get. The Springfield, Massachusetts, Water works costs were given me by Mr. Hazen.

The Indianapolis, Indianac, Fall Creek supply, cost of engineering and superintendence was given me by the President of the company. I was consulted on the construction work before the work was undertaken. This was made up from the final cost sheets.

The Des Moines water works, as to that the engineering and superintendence cost I obtained at the time I was investigating the value of these works and had been worked up by the accountant from the records of the water company, Mr. John W. Alvord of Chicago having been the consulting engineer on the works.

Returning now to page 9, the second page before this, the Charles River basin costs, which are not so significant because the work is not strictly waterworks construction although it involves
7674 the construction of a dam and the locks, and an embankment and conduits were obtained from the official records of the commission. All that I have of record is of the administration and engineering expenses.

The Louisville Sewerage construction covered work of a different character. That was done under the supervision of my partner who acted as consulting Engineer on the work; I saw a good deal of it myself on several occasions when I took his place when he was away.

The Louisville figures were very carefully kept, but they are not as applicable as the others relating to water works.

The next figures are the Boston Transit Commission Subway Construction which involve the tunnelling operations primarily in the City of Boston, the record coming from the American Society of Civil Engineers' transactions and also from the official reports of the commission. The Pennsylvania Railroad tunnel, statement of engineering and superintendence came I think from Mr. Willgus. I shall have to look that up. He is a consulting engineer, a railroad man of New York City, and I think he is probably known to your engineers.

The Washington Bridge, over the Harlem, from a description by Mr. Hutton. He has written a book on the Washington Bridge, and I think it is taken from that book. It is a large document describing in detail the construction.

The next figures cover data assembled by the Pacific Gas & Electric Company, in the working up of which I believe Mr. Lippincott took part, and were given me by Mr. Cutten as you will see by the foot-note there.

(Counsel for Defendants moved that the foot note containing 7675
Mr. Cutten's conclusions as to what those costs were, or what they contained, should be stricken out, and it was done. It was also concluded that the "and contingencies" should be stricken out.) 7676

Mr. Metcalf: On the following page the item of engineering 7677
and superintendence cost of the St. Louis Waterworks came from a report on the supply from the City of St. Louis in 1902.

On the Los Angeles engineering and superintendence cost, I worked that up from figures which were sent to me by Mr. Lippincott at Mr. Mulholland's request. From those figures I worked those up, and subsequently sent a letter to Mr. Mulholland asking him if what I had done was in accord with the facts, and I received a reply from him that such was the case. That 13.7% does not include the 4.7% that Mr. Hazen and Mr. Lippincott worked up. This was upon the basic figures which had been reported on the aqueduct construction. They were based upon the report of Mr. Clemens; they were actually obtained for me by Mr. Bowen, of Mr. Lippincott's office.

Questioned by Master.

I think I am wrong in my statement just made. I believe that the 13.7% was taken directly from "Exhibit 138", in which case it does include the administrative costs of the city officials. The data that Mr. Lippincott first sent me did not include any such analysis.

Then follows an item relating to the Pacific Gas & Electric Com- 7678
pany's Spaulding Dam, which is in accord I believe, with an exhibit which I think has been introduced here. Then data upon a number of filter plants, the majority of which were built by Mr.

Hazen and which I obtained for our committee report from his office several years ago, and the references to the several pages are given in the margin. The others were obtained directly from his office.

Referring to the two sets of figures for Spaulding Dam, one of which I have just referred to in the middle of that page, and the other one at the bottom of the preceding page, the totals being the same, but the percentages different, there has been 2% thrown into administration on the first of those pages. That was in engineering and superintendence in the second one. That is the difference. The first came to me directly from Mr. Cutten, and the second was in accord with that last exhibit. The total amount is the same, but the segregation is a little different.

The different filters came from Mr. Hazen, excepting the last two, the Ashland, Wis., matter I got directly from the chief engineer of the company, Mr. William Wheeler, and the Columbus matter I got from an article by Gregory, which appeared in the transactions of the American Society of Civil Engineers, heretofore referred to.

7679 I have made no direct application of these figures. I have summed the matter up finally as a matter of judgment, bearing in mind these figures which I have worked up from time to time, and the experience which I have had in construction matters, so that they have been used as an aid to judgment, without any direct attempt to apply each one of the items given here. The size of the plant has an influence on the amount of the allowance; it affects various items, more particularly the interest during construction allowance growing out of the longer period required to build the works, which results in heavier interest during construction charges upon the money invested in the plant before the plant is actually put into operation. In the matter of the engineering costs, there is, considerable variation, depending upon the care with which the investigations are made. If the engineering problems involved are worked up in detail before the execution of the contracts, the engineering expenses are, of course, substantially heavier than if the
7680 work is done in a rougher kind of way and then executed by day labor, making possible the changing of plans as work goes on, and perhaps not making such detailed plans as would be necessary were the work let by contract. While that would result in greater engineering cost, I think generally it results in a lessened final cost of the work. It is also true that on smaller work the engineering costs as stated in a percentage of the cost of the work is smaller than in the case of the larger work. That, in general, is true of the overhead costs. That reflects again the time element involved in preparing for the work and the early stages incident to the construction work.

The difference of locality does not, in my judgment, cause the

comparison of these Eastern plants with this plant to suffer, for this reason: If the unit costs of labor which are involved in the prices at which the work is done are lower, then, also, the costs of the administration work will be lower, and therefore, the percentage cost of the administration will not be changed. Broadly speaking, we are limited in the East in working days from the months of April or May to the latter part of November or December, unless there are portions of the work that involve deep excavation, or pumping construction, or dam construction, which can be done under conditions 7681
of extreme cold. I should expect to get a somewhat greater working period per year for the entire work in California than I would in the East, and that would tend to diminish my period during which interest would run. To the extent that it did that, it would make the Eastern interest charges non-comparable.

The first case on the omitted data that Mr. Searls wants was that of the Livermore Falls Waterworks, one of the water district cases in Main in 1907, the award upon which—it being a condemnation proceeding—amounted to $117,698; the overhead allowance was 12½%, including the interest during construction charge, but excluding the preliminary expenses. Those figures were obtained from my own records. I was on that case. You may find it referred to in an article which appeared in the transactions of the American Society of Civil Engineers, referring to the Kennebec Water District, and the Brunswick & Topsham cases.

The next is the Portland, Maine, Water District, which was a condemnation suit, upon which the award was $3,853,033. The property comprised several plants, the more important being the Port- 7682
land plant and the Westbrook and Deering plant. The average overhead allowance of the four engineers representing, respectively, the water district and the company, amounted to 20%. That data is also from our office files, Mr. Hazen and myself having represented the water district in that case, and Mr. Charles A. Allen and Mr. William Wheeler representing the water companies.

Questioned by Master.

The engineers' estimates on both sides agreed as to the reproduction cost. The "L. M. upon reproduction cost" refers to myself. The several engineers agreed upon the reproduction costs within about 3%. Mr. Hazen and I represented the Water District, and our figures were substantially the same; the four engineers were in substantial agreement upon the reproduction costs, including the overhead allowances.

Questioned by Mr. Searls.

These figures all include interest.

The next is the Knoxville Water Company, of Tennessee; the plant was purchased as the result of negotiations between the city and the water company's officials, Mr. William Wheeler, of Boston, representing the company, and Mr. John W. Alvord the city. I was fa-

miliar with that plant, having been down there on construction work for some time. The amount of the award was $1,232,000. Mr. Alvord's allowance on overhead, he representing the city, was 20.3%. It is my recollection that Mr. Wheeler's allowance on that was somewhat greater.

The Indianapolis Water Company is the next—that really should
7683 be stricken out of the list, because it was not an award. It was a joint appraisal by Mr. Alvord and myself, made in 1910, our allowance being 20.9%. The value of the works, in a general way, was about $10,000,000.

No. 5 is the Des Moines Water Company, allowance by the master, in the 1910 suit, 16¼% on a valuation of $1,840,000.

The 6th is the Macon, Ga., water works arbitration, where I chanced to sit as a member of the board of seven, which found a value in the sum of $699,000; the gross allowance was 19% for overhead and interest during construction.

The 3.4% for interest is due to the fact that the works were small in magnitude, so that there was a little over half a year's interest upon the plant. It is located in the south, where construction work may advantageously be carried on throughout the year, as in this region. The amount of the real estate holdings was substantially negligible.

The 7th is the Pennsylvania Water Company award of $2,750,000. That also was a joint valuation, in which Mr. Kuichling and I made an allowance of 18½%. We were representing the water company. The finding of the court was about 85% of the valuation. That is not strictly an award. You cannot determine from the court's opinion just what percentage he allowed. I can only give you a connection between our claim and his final value.

Questioned by Mr. Searls.

The 18½% was our allowance for overhead in that case, and I have given you a measure of difference between our allowance and the court finding. I think that is of less significance to you.

DIRECT EXAMINATION BY MR. GREENE.

7684 The eighth is the New Jersey General Security Company, a finding by a board of three engineers appointed by the State Water Supply Commission recently, that is, in 1912, the amount of the finding being $9,201,240. The total overhead allowance was 16.8%, and on structures only 19½%.

Q. Is that also obtained by reckoning the total overhead on structures alone? A. On structures only for that 19½%.

Q. But you took your total overhead including whatever charges there might have been against the land department and charged it all to construction in order to obtain that percentage, didn't you? A. Yes, they were combined in the same way. I may say that the land holdings were small.

The ninth is the Rumford Falls, Maine, joint agreement of engineers, in a very small plant, the value of which was found to be $125,000, and the allowance was 13.9%.

The tenth was of the San Antonio Water Supply Company, a joint agreement by two engineers representing the city and the company, and the allowance was 18.8%. I was one of the engineers in this case.

Questioned by Mr. Searls.

The value of the plant was something between two and three million dollars; I don't remember the exact figures. We did not determine the value, but it was as to what might constitute a fair rating basis; what we were called upon primarily to determine was the fair basis of contract between the parties at issue.

DIRECT EXAMINATION BY MR. GREENE.

The eleventh was the Denver Union Water Company, in the first instance the allowance by the board of arbitrators amounted to 24.2%, based upon a valuation of $14,400,000; the second, the finding of the master of the federal court of the rating base—not the entire value of the property—in which he made an allowance of 21½%. I may say that in that case the value of the real estate was something less than a 7685
million dollars—yes, it was something less than $900,000, and from that amount the master excluded, if I remember rightly, something over $100,000, so that the percentage of real estate involved was comparatively small.

In the case of the Columbia, Tenn., Water & Light Company, arbitration by three engineers—I chanced to be the third member—involving a valuation of $127,000, there was an allowance of 18%. There was very little land involved in the property.

The thirteenth item is the Roanoke, Va., Water Works, arbitration, the record of which came to me through Mr. Dabney Maury, who was one of the engineers in that arbitration; the valuation arrived at was $1,139,000; on a basis of physical property only, the percentage amounted to 13.8; as based upon the physical property and the water rights, which were valued at 22.7% of the physical property, the allowance was 10.7%.

The next two are small plants, the records of which came to me through Mr. Maury; the first is that of Le Mars, Ia., amounting to about $100,000, where the allowance was 13½% and the second was at Sebring, Ohio, amounting to $87,878, where the allowance was 17½%.

In none of those cases was there included, of course, a plant comparable in size with this, and in none of them did the real estate item of value constitute anything like so important a part of the property as in this plant. In general, the real estate values constituted less than 10%, perhaps averaging, I should guess, somewhere about 7%, from 5 to 7% of the entire value of the property.

Mr. Hazen: Can I make a correction in this last item?

Mr. Metcalf: Yes.

Mr. Hazen: It refers to "Hazen and Metcalf high on account of
7686 large land purchases involving high interest in carrying charges." The allowance I made relates to structures and not to land, land has nothing to do with my figures.

Mr. Metcalf: I may say, your Honor, that Mr. Hazen's remark merely reflects the statement which I have already made with regard to the method of considering the development expenses, the interdependence between the interest during construction charge and the development expense.

Questioned by Mr. Searls.

I do not mean that I have included in my consideration of overhead the fact that all this land had to be acquired, and allowed an extra length of time for that reason, whereas Mr. Hazen has not considered that. It means this, that I have assumed that the interest charge as I have figured it on structures would cease when the structures were completed. Now, as a matter of fact, in the operation of the plant, when you begin to operate the plant, some of the structures will lie idle for a time with interest running upon them after the completion of those structures; that portion of the interest I have accounted for in the development expense; Mr. Hazen has perhaps considered a portion of that in the construction charge when he considers his basic record. This bears upon the amount of the interest during construction allowance as we have figured it. You have to have your land before you commence construction, and so far as the land is concerned,
7687 I have taken into consideration when I attempted to investigate the way in which the plant might be built, in getting the period for which my interest during construction would run the preliminary period during which the land was being acquired, but structures were not being built.

Mr. Hazen: I have not considered the fact that there would be a long preliminary period during which land was being acquired. I have just estimated with reference to the structures. The land question is something to come afterwards. You may please strike my name out of that last item.

Mr. Metcalf: I don't know that I have anything to add on those instances that I have cited there. They give point, of course, to the change in conditions with the increase of the plant which involves a longer period of construction, and of course, a more careful study in the early stages of the project.

ONE HUNDRED AND SIXTH HEARING. FEB. 29, 1916

Witnesses: JAMES MARTIN for Plaintiff.
LEONARD METCALF for Plaintiff.
DUNCAN HAYNE for Plaintiff.
GEO. L. DILLMAN for Defendant.
J. H. DOCKWEILER for Defendant.

Witness: JAMES MARTIN for Plaintiff.

DIRECT EXAMINATION BY MR. GREENE. 7688

I am 38 years of age, and reside at Colfax, Placer County. I Martin
work in the Operation and Maintenance Department, as district manager of the Pac. Gas & Elec. Co., and in the construction department as superintendent of construction work. I have been with the Pac. Gas & Elec. Co. 14 years. As a boy, at the age of 15, 16 and 17, I worked in mines; for that time until I commenced to work for the
Pac. Gas & Elec. Co., I worked in mines or on the surface for mining 7689
companies around their mills or crushing plants in Butte County. My first work for the P. G. & E. Co. was in the shops as a blacksmith and machinist's helper and doing repair work around power houses. During 1905 I was placed on the outside as foreman, and afterwards general foreman in charge of different kinds of construction work. My first job as foreman was the running of a tunnel in Butte Co., in Sterling City, a 650 foot tunnel on the Hendricks Canal. The next job was the placing of a foundation for a 500 k.w. generator at the De Sabla Power House, and some work upon power lines. The next was the building of a concrete diverting dam, at the head of the Centerville Canal, on Butte Creek. The next was the enlarging of the Centerville Ditch, 8 miles, consisting of about 7 miles of ditch, and about a mile of flume, enlarging it from a small ditch to one of 150 second feet capacity. Then came the rebuilding of the Centerville Power House, the enlarging and raising of the walls, and placing of a 5,000 k.w. generator, and a turbine. These Centerville structures are on Butte Creek in Butte County. In connection with this was the Penstock Line, of about 2600 feet in length, consisting of a concrete forebay, and quite a lot of other work. The next job was the running of the 650 feet of, 5 by 7 tunnel in Auburn, a water tunnel; then the building of a diverting dam on Bear River, known as the
Gold Hill Dam. That was a masonry dam. Then about a mile and a 7690
half of ditch, and three-quarters of a mile of flume. The next job was the building of a diverting dam on Bear River near Colfax, known

as the Bear River dam, a masonry dam at the head of what is known as the Bear River Canal.

The next was the job of raising an old dam at Lake Valley, one of the storage reservoirs of the P. G. & E. Co., on the head waters of the American River. The next was the running of a tunnel at Fordice to take the place of the old outlet pipe. The next was the opening up of the South Yuba development, the Drum development below Spaulding. During 1912, and a part of 1913, I had charge of what was known as Division No. 2, which consisted of 8 miles of the 350—second foot canal, the forebay, 6,000 feet of Penstock line, the preparing for it, the trenching and the grading, the building of the tramway, grading and excavation for the foundation of the power house, and the raising of the steel. We built $3\frac{1}{2}$ miles of broad gage standard road. All of this work was under my direction as superintendent. The next was the enlarging of 10 miles of the Bear River Canal in the vicinity of Colfax; this was enlarged from a small ditch to one of 350 second feet capacity. From that job I was transferred to Auburn, on what is known as the Halsey-Wise Development, two power projects; that work is going on at the present time, and I am in charge of it as superintendent. I have built flumes. Flume
7691 excavation, or flume benching, means the benching off of the hillside to receive the stringers on which to build the flume, and where it crosses ravines or depressions, or where it seems best to get across than to go around, it means the repairing of footings for the bench work, either by chipping off the rock and making a flat footing, or by building up little concrete piers. In benching for a flume, you must be very particular as to the grade; you cannot leave any high points in it.

In drilling and blasting in solid rock for flume benching, when converted into actual yards excavated, I believe it is always high. You drill your holes with a light Burden, and blast the solid rock with a light Burden, and that leaves a rough bottom which must be trimmed to grade either by heavy powder cost in bull-dozing, or in digging holes to blast each little hump out.

In material of that sort there is often a little earth work; you would move into the hill and make it a ditch; it is very liable to be either loose rock or solid rock; in other words, the three divisions
7692 are earth, loose rock and solid rock.

I was superintendent on the job during the building of the Lake Arthur Dam, which is an earth embankment, not a large one, in Placer County. It amounts to between 25,000 and 30,000 yards; the raising of the Lake Valley job was an earth job. The building of the Drum Forebay, amounting to nearly 300,000 yards, a little more than one-half of it was placed in 1912 under my direction. The building of our Adam Dam, on the Halsey Development, in the vicinity of Clipper Gap, which work is now going on, between 20,000 and

25,000 yards placed there. Those are the most important of the earth dams that I have had to do with. I know in a general way the property of the Spring Valley Water Co., and have spent time at the Pilarcitos Dam site, and the San Andres Dam Site. My first trips were in the nature of pleasure trips, and I afterwards visited them twice or three times with an idea of estimating the probable restruction costs of such embankment.

Item No. 4 on the inventory, covering the embankment, I have 7693
divided into two classes; on one my estimate is 52 cents a yard, the balance being 70 cents. The 52 cents per yard is for 58,000 cu. yards, which is the amount of material which was removed in stripping for the dam foundation, and therefore, there would be no excavation costs against it. The excavation costs are cared for in the stripping item, or the clearing for the foundation; the balance of my estimate of 70 cents per yard is for the material left in place on the dam. The order in which the work would be carried on is as follows: The stripping for the dam proper; the cleaning to bedrock for the area to be covered by the dam; stripping or the cleaning away of waste material from off of the borrow pits; the excavation costs, either by drilling or blasting, or by blasting or by plowing in the borrow pits, and removing it from the borrow pits to the traps where it is loaded into wagons; it is dumped and afterwards spread out by a road grader to a layer of proper thickness; it is harrowed to bring roots and foreign substances to the surface. The layer near the foundation, and where
the embankment must be first-class, the portion of it that is under 7694
the greater head should be about 6 inches. As the embankment is increased in height, we usually thicken the layers a little, and after it is harrowed then it is sprinkled and rolled. After being rolled, then you harrow it, so as to leave a rough surface, so that two layers will be well connected. That is the way we build our earthen dams.

I have allowed for a distance of 300 feet in scraping into place, and my experience and my judgment tell me that 22 cents would be the cost of moving that material that distance; I have allowed 30 cents for the work on the embankment.

Questioned by Master.

This 58,000 cu. yds. does not come from the borrow pits; it is the material that has been removed from the area that is covered by the dam, and it is taken here and deposited outside, but before you can build a dam, you must take the material that is there above the bedrock and clean that bedrock; while you are doing that, it has to be dropped over. When that is ready to receive material, the first thing you should do is to put that portion of the material back; there-
fore, there will be no drilling or blasting, or plowing cost against that, 7695
and that explains the double handling. The fact that it comes from the bottom makes it necessary that it be measured twice.

DIRECT EXAMINATION BY MR. GREENE.

My segregation shows excavation 22 cents, delivered to the trap 10 cents, hauled to the dam 18 cents, and the 30 cents I used before covered the portion near the bottom where the greater care was exercised.

Questioned by Master.

I excavated my material from the borrow pits by plowing and some drilling, but if material is quite plentiful, we do not do much drilling; we do some shooting to loosen it up, but generally speaking, whenever a borrow pit develops into a firm foundation that requires a heavy excavation cost, we move on and open up another borrow pit. The figure that I have used in hauling cost is 3 or 4 cents for the first 100 feet, and 1½ cents per 100 feet per yard thereafter.

DIRECT EXAMINATION BY MR. GREENE.

I have not used a steam shovel at all in my appraisal, because I believe the steam shovel method for building embankment is not the best. I will admit that the actual excavating and loading into wagons
7696 can be accomplished cheaper by steam shovel methods than by the plow and scraper and trap methods. I believe also that the extra costs that are brought forth as a result of using the steam shovel generally, runs up the cost so that it does not result in any saving.

In order to operate a steam shovel economically, you should work it against the bank at least as high as the full stroke of your dipper. You cannot work it against a shallow bank and work it economically; there may be conditions that you might find a shallow pit where the material would be uniform for a great number of feet, or for a greater depth, but up in the mountains where I have been carrying on the work, the formation changes, it lays in stratas, and using the steam shovel takes the good and the bad alike; it does not permit of a proper selection of the material. We always put the selected and the best material on the inner half of the embankment, and the poorer material on the outer half. If you are taking it by the plow and scraper method, you open up here and you find fine material, and when you want material for the inner half of the embankment, you take it from that borrow pit, and when you are borrowing and removing it to the other half, then you move over to a borrow pit that is a little deeper, and perhaps a little higher, and that has a coarser material, and if you want still coarser material you go to another one. By taking all of these layers with the steam shovel it does not permit of a proper selection of the material. That applies also to the work of Pilarcitos and San Andres. Another question is the amount of moisture. All of these embankments are rolled and compacted, and you have to increase the weight of the material in the embankment considerably
7697 over the weight in its natural embankment with the same percentage

of moisture. If you have a little too much moisture you cannot roll the material; it buckles up on the rollers. In working with a plow and scraper method, if you find too much moisture, you plow it, and the sun shines on it for awhile, and you can come back and get it whenever it is dried out; that is a condition that you can control in the scraper and plow method, but cannot control in the steam shovel method.

The engineers I have worked under have never permitted the tread of animals on the top of the dam as a substitute for rolling or for tamping. My understanding is that it is not so satisfactory. You cannot apply the weight to it, and you cannot compact it so thoroughly. We use a petrilithic roller that weighs perhaps 2 tons, and each layer is rolled as it is applied. We made several tests at different times on different materials, and we were not allowed to cut the number of trips of the roller over to less than 25, depending on the quality of the material.

Questioned by Master. 7698

The dam that I have estimated on is a dam of selected material on the inner face. My costs are direct construction costs, no profit; there is no overhead figured, or engineering, superintendence, contingencies, depreciation, losses of tools and equipment, temporary roads, temporary lines, nor any charges of an overhead nature; I could not supply any such charges; field work and direct field costs are all I have included. No part of my own salary comes into that figure; that includes labor up to and including the foreman. 7699

The excavation was covered in the stripping cost. I am talking about item 4 of San Andres Dam, embankment in place, 469,526; the stripping of the earth, excavation, was approximately 58,000 yards. My balance was 411,526 yards at 70 cents, which was the balance of the embankment which I would have to get from some borrow pit. The 58,000 that I mentioned in my first estimate is covered in item No. 2, 57,940; I have added 60 yards. The excavation I estimated at 24 cents.

DIRECT EXAMINATION BY MR. GREENE. 7700

I have 30,000 yards at 52 cents. I have used the same figures in this item that I used in the others, scraping to the dam 300 feet, 22 cents; work on the embankment 30 cents, making a total of 52 cents for this section of 30,000 yards. The stripping item here calls for 27,127 yards; I have used the 30,000. On the second section of 300,500 yards I have allowed an average haul of 1,000 feet, and my detail of that segregation is as follows: Excavation cost, including drilling, blasting, plowing, 25 cents per yard; delivery to the trap, from the borrow pit to the trap 10 cents; hauling to the dam 20 cents; work on the dam 20 cents, making a total of 75 cents. I would not use a steam shovel there.

One very serious objection to using a steam shovel in embankment up in our country proved to be the large rock that you would get in your dipper and in the wagon, and it would be, of course, dumped on the dam, where it could not be used, and where it was wasted, and the labor cost in connection with moving those large rocks off the dam is quite an item.

7701 I have seen a few miles of the flume of the Spring Valley system, and am familiar with the general character of the country in San Mateo County. I think earth excavation would cost from 40 to 50 cents per yard; that loose rock would cost $1, and that solid rock cost would be $2.75 per yard. Those figures are based on my experience in building a few miles of flumes, and preparing bents and footings for flume bents and flume benches, and from experience in connection with drilling, and blasting and breaking ground.

I do not know in detail the costs which Mr. Elliott introduced in evidence here in relation to Lake Arthur and the Drum Forebay and Lake Valley.

7702 Questioned by Master.

Any figures which I have ever given Mr. Elliott are the direct costs. The only figures I could give him are direct construction costs. I have not the costs of the Lake Arthur, the Lake Valley, or any of those old jobs; and while I, at one time, had them, I think it is proper to say this, that during those days we had a man on the job who kept those costs under my direction, but if it was not a large job, I kept those costs, but there has been, in times past, so much confusion and misunderstanding in quoting those costs, that while I would give them a direct construction cost, with no overhead, we found that the fellow in quoting them afterwards, or in using them, failed to give the explanation which I gave. All my costs have been given without the overhead, and all other costs were to be applied, and I would expect
7703 to get them at some later date. I think the information given by Mr. Elliott, was information gathered on the job during his visits there, and I think they were verbal statements of mine.

CROSS EXAMINATION BY MR. SEARLS.

I kept the record of the cost of building a trap; I know how many carpenters worked on it, and their rates of wages, and the amount of time they put on it, and in drilling I note how long it takes a man to drill a hole.

7704 The powder bills did not come to me. On the Lake Arthur dam we tallied the yardage as it was placed on the dam by the number of wagons. To the best of my knowledge the completed embankment measures up about 22,000 cu. yds., and our tally would show about 29,000 cu. yds. of loose materials was hauled on to the dam. Those figures are from memory. When I say "measured up", I mean the

finished embankment. The payrolls are made up on the job. I had charge of the hiring of the teams also, and those bills were approved by me before they were paid. The materials, powder and other matters, did not come through my hands at all. The information I gave Mr. Elliott contained the labor of men, hiring of horses and wagons—I could not state positively whether the cost of powder, caps and fuse, would be included in the excavation costs or not. All of the men on the job were not working on the embankment, but all the work there 7705
pertained to the building of the dam.

My costs, as applied here, and as I, without doubt, used them there, covered the men actually employed on that kind of work. I took the crews that were working on the dam, borrow pits, traps, etc.; work in connection with the placing of the embankment. I consider that the work on the P. G. & E. dams up there was economically done. The material there was not adapted to the use of steam shovels, because there were too many loose rocks in it. We did not try a steam shovel at Lake Arthur, as the material was good red earth, with some boulders, which are commonly called nigger heads, mixed through it. It is the ordinary foothill material of that portion of the Sierras, and that material stands up pretty well in banks. We did not try to use a steam shovel there; we had not any such equipment at the time; the decision of the engineer who controlled the job, was that steam 7706
shovels should not be used. That was in 1909, but I do not think it was before steam shovels were in general use on work of that kind.

I have done steam shovel work at Drum Forebay and on the Drum Canal, and on the Bear River Canal, and on the canals we are now building in the vicinity of Auburn, and on 3½ miles of what is known as the Drum Railroad. The steam shovel was not satisfactory on the Drum Forebay. The extra costs of the result of trying to use it in that kind of material brought about the decision to have it set aside, and proceed with the work in the scraper and plow method. The Drum Forebay is at about 4400 feet elevation. We did not encounter granite there. I do not think that we had to do any more shooting there than we did at Lake Arthur.

Questioned by Master.

The material at the Drum Forebay is a volcanic material. At Lake Arthur it was the red earth of the foothills, with occasional boulders through it, but without any rock in place, or granite, or any- 7707
thing of that sort. At the Drum Forebay there was a volcanic material that lay in layers; a part of it would appear to be volcanic ash, which had been subjected to considerable pressure, and was quite firm and would cut out nicely, other parts of it would appear to be boulders, but really hardpan, and the men would have to take a sledge hammer and work a few minutes to break it up. Large sections, you could not get in and handle on the dipper; you could not put them on a dump wagon; sizes of that kind would have to be bull-dozed, and

very often would have to be drilled; it is not red earth country up there at all.

CROSS EXAMINATION BY MR. SEARLS.

At Lake Valley we had to raise the dam. There are a lot of local conditions which entered into the Lake Valley work which made, in some ways, rather a difficult job. The mere raising of a dam would not be so expensive as to prepare foundations and build from the ground up. With respect to Lake Valley there was quite a long haul; borrow pits were opened up, and the traps were moved quite frequently, owing to the scarcity of material. There is a wooden core in the Lake Valley Dam, and whenever you raise a dam with a wooden core it means a lot of hand work, and a lot of cost that you do not have in an embankment without a core. The day shift works over the core,
7708 and places the material, and the night shift comes in and digs a trench, and increases the core wall, and builds it up, perhaps, for a foot, or nearly to the crest of the dam; and then it is again covered up. The digging out of this material, and nailing on of the core, and again compacting that material, is all hand work. The Lake Valley Dam has a redwood core.

DIRECT EXAMINATION BY MR. GREENE.

Lake Valley lies east and south of the railroad, and about 2½ miles from Cisco; it is in Placer County, and the Sierra Nevada Mountains, at an elevation of about 5,900 feet.

Questioned by Mr. Searls.

The dam was built many years ago; most of their earth embankments at that time were built with a wooden core. I imagine the poor quality of the material available governed them in that respect. In
7709 the embankments I have worked on I have had the selected material placed in the inner half, gradually tapering to the poorer material on the outer face. I have never done any work on the Coast Range. My work has all been in the Sierra Nevada Mountains. I have no great familiarity with the character of the material that I would have to excavate in the Coast Range, outside of the examination I have made of the Spring Valley dams.

Questioned by Master.

I think that my many years of experience in blasting and drilling ground enables me to form an estimate as to the cost of breaking solid rock down here. There is not a great difference in my mind in the drilling and blasting of solid rock, whether it be granite or green stone, or diorite.

DIRECT EXAMINATION BY MR. GREENE.

7710 I see no difference between the country in the mountains and the San Mateo country. Earth to me means material which can be

loosened by a pick and shovel by hand. It may be a decomposed granite, or it may be a shale, or something of that nature, but there is not a great deal of difference in it.

Questioned by Mr. Searls.

It is my idea that the blasting of solid rock in the Sierras would cost for flume benching $2.75. I have done a lot of blasting in granite and other kinds of rock up there, and my idea is that it would cost $2.75. That is my general idea as a man in charge of work. While I have not the cost data report, my experience tells me that earth work of that nature costs about that amount.

I walked over some of the flumes of the Spring Valley Water Co.,
and looked over them as a practical man would look over a structure 7711
he was interested in. I walked over some flumes at Pilarcitos, and I have in mind some flumes leading from San Andres down. I examined the character of the embankments, and to the best of my knowledge, I found solid rock there such as we have in the Sierras. I am not in a position to state just how much of the flume of the Spring Valley Water Co., over which I walked, required benching work, and just how much required blasting in the solid rock. My statements are that solid rock benching excavation would cost so much, loose rock would cost so much; just what percentage of these flumes would require this
particular work I would not say. I could not say whether the rock 7712
that I saw there was the same character as the rock I have dealt with in the Sierras. It is a pretty broad statement, but solid rock is solid rock.

I appraised the San Andres and Pilarcitos Dams, and for the
stripping of San Andres Dam I gave 24 cents. On the San Andres 7713
I have grubbing, blasting stumps, plowing and scraping, 100 feet, 16 cents. On the Pilarcitos I have plowing scraping 100 feet, 16 cents, now back again to San Andres, I have plowing and scraping 300 feet, 24 cents. And back to Pilarcitos again I have scraping and moving 400 feet, overhauled 32 cents, so I used practically the same figure.

Questioned by Mr. Searls.

I made an examination of as much of the borrow pits at both of those dams as could be seen. Without doubt most of the material was obtained from within the reservoir site. I do not think that it was a short haul.

Questioned by Master.

I gave 20 cents for wagon hauling; this is stripping. This stripping item covers the stripping of the dam-site itself; this does not include or consider the haul from the borrow pits to the dam. I think I used 1,000 foot haul, but I am not certain as to whether I used it right straight through.

At San Andres I have used a little over 1,000 haul, and at Pilar- 7714
citos I have used 1,000. At Pilarcitos I have this: Delivery to the

trap 10 cents; haul to the dam 10 cents, which is less than 1,000 feet, as I have used 1½ cents per yard for 100 feet; work on the dam, 20 cents. The corresponding figures on San Andres are as follows: Excavation 22 cents; delivery to trap 10 cents; haul to the dam 18 cents; work on the dam 20 cents. The average haul was about 1,000 feet. That is for Pilarcitos; that is in a general way, and I have no way of knowing the exact haul required. The average haul for San Andres would be 800 feet.

Questioned by Mr. Searls.

The figure of 22 cents which I used for excavation alone from borrow pits, I did not make any analysis of. The excavation was 22
7715 cents. I evidently figured on some blasting; just how much I could not say just now. I have no way of making any examination to determine where my borrow pits would be, as the reservoir was full of water. The material within the reservoir site is without doubt the same now as that surrounding it. I could not take my oath that it would require blasting, or that it would not; it is just a matter of judgment.

The plowing cost, I believe, would not be as high as 22 cents. What the plowing cost would be would depend. I have kept costs on that item in the same way that I have kept costs on any work that I do. It all depends on the material; sometimes you can set your plow so that it cuts 8 inches; in other places you could not cut 5; sometimes 4 horses will pull a No. 3 plow; sometimes you have to have 6 or 8 on it. I cannot tell you just how much I allowed for
7716 plowing on the San Andres, or just what I allowed for drilling. I might say that if the ground is properly drilled and properly blasted, it won't require plowing, or at least very little. I think my statements of my field costs awhile ago applied to that cost of 22 cents a cubic yard to loosen the ground and take it up in scrapers, or any costs that I might have had. It is just a matter of judgment. In
7717 figuring the construction of the Spring Valley dams, I figured on the rolling and compacting method. I figured on a puddle core, and the entire inner half of the embankment to be rolled as I believe these were, and should be.

I have figured the same amount of compacting in this dam as I have used on those I have constructed. All the work I have done required such compacting. I have worked under the direction of engineers, and my opinion as to whether it is necessary or not has
7718 never entered into it. I have never built a puddle core dam before with an entire puddle core in the center; I think perhaps there is not a great difference in this puddle core and the work I have in mind doing for the inner face of the dam.

To the best of my knowledge the work carried on in the mountains has cost us more than 20 cents. The cubic yardage per day depends entirely on the number of borrow pits you work, and the

nature of the weather and so on. Assuming the conditions at San Andres, I think it would be possible to place a very large yardage; it might be more economical to work a smaller and a better organized 7719
crew. I have not thought of it enough to answer intelligently as to how many yards I would place in a day. I have not thought of the exact amount of equipment that would be used, but as to the number of men, my answer as to the amount of equipment would apply. As to the wages, that enters into this very materially. I assumed a 9-hour day, and $2.75 for laborers, to the best of my knowledge. The rates range from $2.50 to $3.00 and $3.50 and more for foremen; you are obliged to pay more when a man drives six than when he drives four horses.

Questioned by Master.

In making this estimate on the Spring Valley structures I modified my figures in the Sierras as regards hours and wages. We worked 10 hours there for awhile, 9 hours is now a day's work. I believe you are obliged to pay a little more for your labor, and for all classes of work down here than we are obliged to pay in the mountains. My experience shows what it would cost for work at 9 hours in the Sierras, and I have used 9 hours down here, and I have assumed my estimate of wages. 7720

Questioned by Mr. Searls.

I understand, as a man who handles and hires a large number of working men, that higher rates are paid nearer the larger cities, and I know the union holds you closer to their rules here than they do in the mountains. I have not carried on any work in this vicinity. In the Sierra work I paid from $2.50 up. We are now paying 25 cents an hour for laboring men. During the better times of 2 or 3 years ago laborers were paid $2.50 and $2.75. Even on the upper part of our development we are obliged to pay $3 in the late fall, owing to the extreme cold weather.

The earth dams which I have in mind, were not on the extreme upper end of the system. I don't remember the exact number of working days in the year, or the days we were unable to work. We often have a late fall up there. I expect the season up there to be 7721
somewhat shorter than down here. In some respects the petrolithic roller may be the same principle as a horse treading on the ground. It is really a rolling tamper.

RE-DIRECT EXAMINATION BY MR. GREENE.

The total stripping costs were 48 cents on Pilarcitos, and 40 cents on San Andres. The 48 cents for stripping Pilarcitos is made up of 16 cents plowing and moving 100 feet; 32 cents for moving 400 feet more—and overhaul.

As to San Andres, the 40 cents is made up of 16 cents for plowing and scraping and removing stumps for 100 feet; 24 cents for

removing 300 feet overhaul by scraper methods. That makes the totals 48 and 40 for stripping.

7722 For the plowing and moving for the first 100 feet on Pilarcitos it is 16 cents; the overhaul of 400 feet at 8 cents per 100 feet would be 32 cents. On San Andres: Blasting stumps and plowing, moving the first 100 feet 16 cents; 300 feet overhaul, at 8 cents per 100 feet, 24 cents, making a total of 40 cents.

7723 Mr. Hazen: Referring to yesterday's transcript, at the top of page 7642, it should be "Spring Valley", otherwise, it seems to be correct.

Metcalf

Witness: LEONARD METCALF for Plaintiff.

DIRECT EXAMINATION BY MR. GREENE.

7724

(Certain corrections noted in the transcript by witness).

I did not yesterday wish to imply that work is not carried on during the winter months on large public works in the East; what I did mean to imply was that where you had trench work which would have to be done in frozen ground, that portion of the work, of course, we would aim not to do when the ground was frozen. Of course, as I stated, dam construction does go on.

7725 The Kensico Dam has been under construction continuously for several years past, as has tunneling work being carried on by the city. Our sewer work, where the cut is deep, is carried on continuously. We do a great deal of water front work and concrete building construction. We carry that work on except on the very coldest days by heating the material and covering the walls of the building. In mass work also concreting is done in the winter season in freezing weather, although in the coldest weather we shut down; that is to say, there is a limitation below which we do not go. Sometimes salt is added to the water for the same reason, and the work is covered up after completion.

The overhead cost has been predicated by me upon the structures only, and without reference to the lands. In discussion of the lands—which will be taken up at another point in my evidence—in that I have made an allowance for engineering and legal expenses upon the land of but 3% as compared with the 15% overhead on the structures. I have made no additions for the cost of assembling the lands, or the severance damages which might accrue. In the discussion of the interest-during-construction charge, in order to make that perfectly plain, I would say that I considered the thing first, en-
7726 tirely separate from the point of view of the structures. Subsequently I made a computation in connection with the determination of the development expenses, in the discussion of which it is necessary to make some assumption as to the order of proceedure in

the construction of the work, and the way in which revenue would be acquired, and the operating expenses would be incurred. When I made that computation, I considered the land as well as the structures. I assumed, in making that computation that as soon as any structure was built it went into service, regardless of whether it would earn an adequate return or not, accounting to the development expense any deficiency in the ability to earn the interest charges on the cost of the structure after the completion of the structure. By that method of computation, and assuming that the structures went into service immediately upon completion, I found that the interest during construction upon the structures and the lands combined, based upon the figures of our real estate witnesses upon the value of the land, amounted, on a 6% rate of interest, to 11%, and on a 7% rate of interest, to 13.1%. If I had made the assumption, in making that computation, that the interest during construction upon the structures, after being built, should continue as part of the construction cost, until the total completion of the plant at the end of the 6-year period, I should have found upon the same assumptions an interest-during-construction charge upon the structure alone, of 13½% on a 6% rate of interest; at a 7% rate of interest a 16% interest-during-construction charge. Those facts, coupled with a review of the data which I had in hand, lead me to adopt on the structures alone, a 15% overhead cost plus a 12% interest-during-construc-
tion allowance, based upon the basic unit figures, plus the 15% over- 7727
head, making the total overhead and interest-during-construction allowance 28.8% upon the basis unit figures.

Questioned by Mr. Searls.

As applied to the structures, my interest-during-construction included no reference whatsoever to the lands. As applied to the computations which I made in connection with the development expense, I did combine the structures and the lands, and I did make allowance for interest during construction, which would be incurred upon the lands from the time they were purchased until they were assumed to be put into use, when a particular structure built upon them also went into use. The 12% interest-during-construction is interest-during-construction during the period in which the structures alone were being erected, and it does not take into consideration the additional length of time necessary for land acquisitions.

Witness: DUNCAN HAYNE for Plaintiff. Hayne

DIRECT EXAMINATION BY MR. MCCUTCHEN. 7728

I am 52 years of age, and I know the property purchased by Mr. Francis Carolan. I own 1/10th of it. Half of it was owned by the five heirs of the estate of Agnes Bowie, deceased. The other half was

owned by the six heirs of Wm. Howard, deceased. It was owned in twentieths. One of those who owned a tenth conveyed a part of his interest to an outsider. There were at first 11 owners, and then 12
7729 owners. I was in Europe at the time that the contract was made. When I returned I found that there was a contract of sale of about 1100 acres, with certain water rights, to Mr. Carolan. That contract was not consumated in entirety. There were objections made by Mr. Carolan to the title to the water, and there was also a question over a deposit. He made a deposit of $25,000, according to my memory. After my return from Europe, there was a good deal of dispute over the matter on the question of title to the water. There was also a question over roads. There was only one road at the lower end; at the upper end there was no road for nearly two miles. There was no access to the property. We had made efforts with the Crocker interests to gain access to the property, but they were unsuccessful.

The deposit had been taken by the heirs, and after a great deal
7730 of negotiation, Mr. Carolan waived all right to the water, and took a little more than one-half, and we let him off of the purchase of the other part; that adjustment was not satisfactory to me. I expressed a wish to call the transaction off, and several of us wanted to get out of the contract. They even went so far as to agree on getting an attorney to fight it out.

The property was owned by some owners, who all pulled different ways, so that it was very difficult to handle. Therefore, I finally agreed, after solicitation of others who wanted it to go through, to let it go. Otherwise, I never would have sold it at that price; we reserved all water. I am not positive that it was $25,000 that had been put up as deposit, but whatever the sum was, it had been used,
7731 and appropriated for some time before. It was suggested that it would be somewhat embarassing to return the money at that time. I had, at that time, a considerable familiarity with real estate values in that locality. I was interested in property from the bay clear up to the top of the mountains. I would say $325 an acre was not an adequate price for that property at the time Mr. Carolan purchased it; it was a dirt cheap buy.

CROSS EXAMINATION BY MR. SEARLS.

The total acreage of that tract was about 1140, and Mr. Carolan finally acquired title to only 540 acres. If he desired to insist on his rights under the contract, he could have acquired the entire 1140 acres.

RE-DIRECT EXAMINATION BY MR. MCCUTCHEN.

7732 The other portion of the property which Mr. Carolan took was by far the more valuable part.

Witness: JAMES MARTIN recalled for Plaintiff.

DIRECT EXAMINATION BY MR. GREENE.

I secured from Mr. Elliott, and from the transcript of the proceedings, the figure he gave as being the costs of the earth in place for the Drum Forebay and at Lake Arthur. Those figures are correct.

CROSS EXAMINATION BY MR. SEARLS.

I am not able to give you any idea of how I made up those figures. The field costs, as kept by myself, have been turned into my city office, and were introduced at our recent hearing before the Railroad Commission. The details of my records, by which I arrived at a field cost of 70 cents, are shown by the records of the Railroad Commission. I cannot show any data in my possession which gave me those figures. 7733

Witness: LEONARD METCALF recalled for Plaintiff. Metcalf

DIRECT EXAMINATION BY MR. GREENE.

I have prepared a brief statement in regard to the interest-during construction items similar to that which I prepared on overhead, citing certain statistics which I had worked up, and including those which Mr. Hazen presented in testimony a few days ago.

"Before the construction of works of magnitude can be undertaken, financial arrangements must be made for the advancement of the necessary funds. If the period of construction involved be comparatively short, such as one or two years, it has generally been found advantageous, if not necessary, to borrow the entire sum needed in advance of construction. If, on the other hand, the period of construction is a long one, such as 5 to 10 years, it is generally found advantageous to make arrangements for the advance of stated sums during the time of construction period. Generally, bankers and underwriting syndicates prefer, however, to make arrangements for the basis of purchase of the entire bond issue, though the bonds be delivered at stated intervals in blocks, and allowance be made for repayment of a nominal rate of interest, such as 2% upon unexpended bank balances.

"Necessary financial arrangements, therefore, involve the payment during the construction period of interest upon the funds borrowed, or advanced by the owner of the property. It is logical to include these interest payments in the construction costs of the 7734
property up to the time when the workable units of the plant are put into actual revenue producing operation; the interest payments involved by the investment in the unit of operating property should be accounted in development expense during the period in-

"volved in the acquisition or establishment of the business to the "point where the earnings are sufficient to meet the fixed charges, "as well as the operating expenses and depreciation allowance; "thereafter, the interest payments should be accounted as fixed "charges, to be met from the net revenue, or divisable earnings of "the property.

"The determination of the exact time when the different work- "able units of the property may fairly be assumed to have crossed "the dividing line between the 'construction period' and the 'de- "velopment period' is difficult; but fortunately, this is not a matter "of controlling importance, if proper allowance be made for develop- "ment expense or going concern element of the value of the property.

"Records of Actual Interest During Construction Costs Upon "Other Works.

"In the following tables are given:

"A summarized statement of interest-during-construction costs "upon 34 public service projects, based upon the actual rate of in- "terest paid, upon a 5% rate, and upon a 6% rate, compounded "annually; the period of years involved in the construction, and the "date of completion assumed, although the final date of completion "was, in most cases, later than that shown; and the reported total "cost upon which the interest-during-construction costs are based.

"It is to be noted that the reported total cost here used may,
7735 "in some cases, be less than the final cost, growing out of the fact "that in most cases the cost of lands has been segregated so that the "figures cited relate principally to structural costs, and because of "the further fact that the additional amounts expended, after the "plant was put into operation, have not been included in the base "upon which the interest-during-construction should be figured.

"2. The detailed data and computations upon which the summar- "ized statments are based. These have, however, been grouped with "the detailed data regarding the overhead costs.

"The interest-during-construction has been figured at the sev- "eral rates cited (at actual cost, and at 5%, and 6%) in order to "give information as to the effect upon this item of costs of the "credit of the borrower, and hence, of variation in the rate of in- "terest paid upon the funds advanced, though without allowance "for the necessary profit item.

"Conclusion Upon Interest-During-Construction Expenses.

"It will be noted that on not only the magnitude, but also the "character of the structure involved, and the rate of interest paid, "have an important influence upon the amount of the interest-during- "construction costs.

"In general, it may be said, that the actual interest-during-con- "struction costs involved in waterworks construction in this coun-

"try of late years has ranged from about 15% for the works of first "magnitude, to 3%, or thereabouts, upon the smaller works which "can be built within one building system, the interest-during-con- "struction rate being applied to the combined fair contract cost and "overhead expenses of the works under consideration, and at the "rates of interest paid for money by our cities, from 4% or less in "the wealthier and larger cities, to 5% in the less resourceful and "smaller."

I have assumed a total percent allowance, based upon the com- 7736
bined fair contract cost of the physical property, and overhead charges thereon, to be fair for these works, and to be in keeping with the actual experience had in the construction of works of similar magnitude in different parts of this country.

"A detailed analyses was also made of the fair allowance for "interest-during-construction, based upon the progressive invest- "ment which might be incurred in a rational reproduction of the "existing plant, assuming as the date of valuation, December 31, "1913, and construction period of six years thereafter, ending De- "cember 31, 1919, the greater part of the first two years being as- "sumed to be necessary for preliminary investigations, preparation "of plans, obtaining of options upon, and finally making purchase "of, the lands, rights of way, and riparian rights necessary to the "acquisition of the property and construction of the physical plant.

"The detailed analyses indicate that at a 6% cost for the money, "the total interest-during-construction cost, expressed in percent of "the assumed investment, would amount to 11%, and upon a 7% "rate to 13.1%."

If the interest-during-construction charges be covered up to the completion of the plant, that is, for the remainder of the six year period assumed as necessary to design and build the plant, the 11% and the 13.1% would become, respectively, 13½% and 16% upon the structural plant.

"Reviewing the various assumptions made, and results thus "obtained, an allowance of 12% of gross reproduction costs" based upon the unit figures, plus overhead expenses, appears reasonable.

Then follow the tabulations referred to; the first case being that
of the Board of Water Supply, the analysis for which was given by 7737
Mr. Hazen. Then follow certain contracts under the Board of Water Supply work, which were analyzed independently, and give an idea of the range of the interest account upon structures of different character. These records appear upon the official reports of the water supply of New York City. The first of these was the contract numbered 80, grade and pressure tunnel, the rate being assumed at the face rate of the bonds. At the time these records were made up, we did not have a detailed statement of the premiums account, and they were based upon the face of the bonds. In that case, at a 4%

rate, the expenditures made under this contract from year to year, compounded annually, amount to 9%. At a 5% rate to 11.3%; at a 6% rate to 13.7%. That is reckoned at the time when the structure was completed, and not to the time when it was feasible to put
7738 it in service. Those structures were completed a very long time before it was feasible to put them in service, and that is the reason for the difference in percentages between the units referred to and the total percentage upon all of the work to which Mr. Hazen has previously made reference.

Questioned by Mr. Searls.

If you knew the exact dates at which you wanted all your structures to go into commission, you could make an assumption at which to commence the different items so as to bring them all into effect on that date, but the difficulty is it becomes exceedingly speculative. In construction matters you cannot always control those conditions. Every estimate that I have ever made, based upon that sort of analysis, has underrun a fair allowance, or the actual cost of the interest-during-construction, when measured by the finished work, just as in this case. I believe that it would not be advisable on a large work to attempt an approximation of the date on which all of the items would go into effect, and to commence the construction of the different units accordingly. For instance, on this work, the smaller city reservoirs and the pumping stations could be built, I have assumed, within a period of one year; there are a number of the other more important structures, the construction of which
7739 would require two years; then the Crystal Springs Dam, which would require a longer period of three years, or so, and then the pipe system, which would require five years. Now, if you were to make your estimate upon the basis of building all of the structures so as to have the plant ready to begin at the end of the longest period required, you would do a tremendous amount of work in the last year. You would carry a heavy investment in the pipe system in the first years without getting any return upon it, whereas, good business would dictate building your plant in such a way as to enable you to get the largest return financially that you could at the earliest possible moment. So that you would actually begin, as is shown by my assumption here, to operate at the end of a three-year period, although the entire construction period would be six years.

Mr. Hazen: As a matter of fact, this New York aqueduct work was laid out in just the way that Mr. Searls has indicated, so that the different parts would be completed at the same time as nearly as could be expected. What happened was this: There was one weak link in the chain, and that was about 15 months slow in being completed; all the rest of it was completed, but it was held up until that small link in the chain was finished.

Mr. Metcalf: That was a special case where you could not use 7740
your water until the entire conduit was built, was it not Mr. Hazen? In this case you might develop one nearby source, and then a remote source, and then a still more remote source. To give a practical example of that, when the present City of Gary was built, they laid out a water supply and sewerage system. The water supply involved the construction of a tunnel running out into the lake, the construction of which would require a considerable period of time, perhaps two or three years. In order to get a revenue as quickly as possible, they took their first supply from a series of driven wells along the lake front, which were subsequently abandoned when the tunnel was completed out to the lake. They found they were well able to afford to do that, because of the earnings which resulted from that course of procedure which helped them pay the burden of the investment.

Questioned by Mr. Greene.

I think, where it is possible, as, for instance, where you have several different sources of supply, some nearer than others, that plants are built in stages, and in such a way as to enable you to get your revenue as rapidly as possible, and to cut down the interest charges which will result, and also to enable you to spread your work over a little longer period of years, thereby getting somewhat better efficiency in construction.

Questioned by Mr. Searls.

In the case here, to build the Pilarcitos Reservoir first wouldn't 7741
be a drop in the bucket, metaphorically speaking, but it takes time to build your distribution system. It was my idea that the first development would be in Lake Merced, which was nearer at hand, and which could be connected up more readily, and so you could actually be getting a return from the water derived from that source before you could hope to complete the construction of Pilarcitos Dam and the aqueduct leading into the city from it.

DIRECT EXAMINATION BY MR. GREENE.

The data here submitted, I think, is substantially identical, at least as to the sourses, with that submitted yesterday. Case No. 15, Denver Union Water Co., Cheesman Dam, I got from the actual records of construction of the dam. I have done some work for that company for a number of years. The Cambridge records came from the Water Department's report; also the New Bedford; also the Portland, Maine, Water District. In all of these cases, I have no doubt that there was correspondence between my office and the Department in order to clear up any matters not covered by the report. 7742
The figures of the Pacific Gas & Electric work were derived from the exhibit filed before the Railroad Commission. I know nothing further of them than the fact that they are quoted. I have no per-

sonal knowledge of any of those projects. Of the Los Angeles work, I have seen something, but I actually made those figures myself quite independently. With regard to the Los Angeles figures shown in No. 16, above 20%, in the exhibit quoted, it appears as 19.4%. I made computations quite independently before I got this exhibit upon data furnished me by Mr. Lippincott's office, which came from the official records, and which showed, I think, 21.2% interest-during-construction, but as against that, some allowance should be made for interest earned on deposits in the bank, concerning the amount of which I could get no specific information, except that it was small, and I was informed that a 2% rate was earned on some of the balances. The account, however, was merged with the other accounts of the city, so it was impossible to form a definite judgment as to the amount of this offsetting account. I, therefore, called the 21.2% approximately 20%.

7743 We were informed that the Spaulding Dam of the Pacific Gas & Electric Co. was a rush job, and to that extent that information is hearsay.

Questioned by Mr. Searls.

I think the Spaulding Dam is a very good structure. I do think that it would have been advantageous to have built it more slowly, on account of the fact that that very rapid building developed temperature conditions which do not seem to me desirable, and which I think probably had the effect of somewhat increasing the leakage in the dam. I think that a slower rate of construction would have avoided some of that. It is a very good structure, though, and a very creditable one to the builders.

The New Orleans Waterworks records were obtained from the
7744 reports of the department, as were the Chicago records.

Questioned by Mr. Greene.

In the matter of the Chicago records I have a description here of the work, which was taken from the 30th Annual Report of the Department of Public Works of Chicago, for the year 1905, covering the new Southwest Land & Lake Tunnel System; also reference to the 36th Annual Report for the year 1911, and I think some other reports.

Questioned by Mr. Searls.

In the matter of the Cambridge work, I have a brief description worked up from different sources, and then some figures which represent the actual payments made by the Water Board, as given by the Water Registrar's report to the board. We had some conferences with the Water Registrar. Also reference to Mr. Hastings, City Engineer of Cambridge.

I do not seem to have the reference as to the New Bedford case. I feel confident we got that from the reports of the water department of the city.

Questioned by Mr. Greene.

In these detail tables some of the figures are derived by me from information that I have gotten from others, and do not appear formally in the reports which I have consulted in the same shape 7745
in which they appear here. The figures which we took out of the reports were the expenditures from year to year on account of the different work. The computations with regard to the 5% and 6% rates were made by ourselves.

The last one, No. 37, was based upon the available records of the Crystal Springs Dam construction. In that connection it might be well to refer to what is stated here in the footnote, and perhaps amplify it. The construction of the Crystal Springs Dam began in February, 1886, and was completed in December, 1890, although some additional expenditures, aggregating about $65,000, were made in the intervals of time between 1890 and 1895. I have ignored those instead of charging the interest charges forward.

Questioned by Mr. Searls.

They may mostly be for land. The structure was subsequently raised a little, and I was not sure that that was not in here. The construction was suspended during the year 1889. I therefore excluded, in figuring the interest-during-construction, this year of idleness, although, obviously, the investment that had been incurred was carried forward on the assumption that the construction for the year 1890 was executed in 1889. Had the computation been made on the basis of completion on December 31, 1890, including the year 1889, as it actually occurred, the interest-during-construction would have amounted to 15% on a 6% rate, instead of 9½% as shown, and to 17.6% upon a 7% rate. Under the circumstances, however, and considering the fact that some service was gotten from the structure before the completion of that item, it seemed fairer to me to 7746
compute it on the shorter period of time, omitting that year. That merely illustrates one of the difficulties of computations of this sort. Some assumptions have to be made. It is my impression that they did have some service from the Crystal Springs Dam earlier in the stage of the work, and that is the reason why I omitted that year, and simply dropped it out as if the work had gone on uninterruptedly.

The amount expended on the structures in the year 1886 7747
amounted to about $26,638, as I have it, and on land, $196,958. Then during the year 1887, on structures, $463,000, and land, $60,520. In the year 1888, on structures, $1,097,124; on land, $5,000. In the year 1890, on structures, $329,388, and no expenditures on land. Mr. Sharon worked that segregation up for me on such data as he had. It is made up from both Mr. Wenzelberger's and Reynolds' reports on expenditures.

Witness: GEO. L. DILLMAN recalled for Defendants.

7748 DIRECT EXAMINATION BY MR. SEARLS.

Overhead includes all general charges which cannot readily be charged to separate items of an estimate. They are variously listed by different engineers. There seems to be no uniformity in the matter, but for this estimate it will be segregated as follows:

1. Preliminary Expense. Including preliminary engineering, legal expenses and franchise. These can properly be considered in toto.

Taking the estimate on structural properties without overhead at $16,000,000, two-tenths of 1% will amount to $32,000, and this figure is probably all that will be expended in preliminary work for this water work.

2. General Expense. Including general officers, legal and accounting expenses. This might also be called an administration expense. One percent will be used to cover this item.

3. Engineering. This is estimated at 5% to include salaries, traveling, office expenses of reconnaissance, location, designing, laying out, supervision, inspecting, computing and estimating work. This is ample to cover all necessary expense in this direction.

7749 While I am aware that engineering often costs a larger percentage, the larger percentages, in my experience apply to the smaller systems, or to a desire to have engineering done by alleged specialists, whose benefit to the work has always been expensive in my experience, and these additional expenses are often detrimental instead of a benefit to the system. So far as my information goes, Mr. Schussler was able to plan and supervise the construction of these works without expensive consultation, and I am assuming that a man of Schussler's engineering and business ability will be at the head of this construction corps.

4. Taxes and Insurance. These will be considered together, and as they apply only to a small amount of material, and also include liability and fidelity insurance, and the responsible contractors will carry their own insurance in the prices put on these contract jobs, .5% should cover these two items. Taxes on new construction, of course, only begins the second year.

5. Contingencies. Here is where there is no general guide. Each estimator's experience will be different; the same man's experience will result in enormous variations in two almost similar and comparable jobs. In this estimate, the figures as given as fair contract prices are intended to cover them. They are properly included ordinarily in the item "Contractor's Profits". As contingent expenses increase, profits decrease, and vice versa.

Taking it by and large, the greatest percentage that could reasonably be added to any, even a preliminary estimate, would be 10%. Fully half of this is obviated by the great detail with which the inventory is compiled, and the agreement thereto. Fully half the remainder

is included in carefully figured unit costs. The proper percentage for contingencies depends upon the care with which an estimate has been made. This is a very carefully prepared estimate, based on agreed 7750
quantities, so if 2.5% is added for this item, in my opinion, no injustice will be done the water company.

6. Interest-During-Construction. This is considered in my estimate as a separate item from general overhead, and is shown in the various items estimated. I have considered in this that while the construction may last five, or possibly six years, that no one item of construction will drag along over three years from the time it is begun until it is in service earning revenue. I have assumed an interest rate of 5%, as it is my belief that at almost any time, and certainly for a large percentage of the time from 1907 to 1913, money could be gotten on such good security as the Spring Valley property at that, or better, and I have computed on the basis of one-half period of construction for each unit.

The above is my analysis of overhead. It amounts to 9.2%. If this is increased to an even 10%, it will accord with my practice in such matters for many years. I have found generally, of late years, that this allowance added to my construction cost estimates usually results in a surplus at the completion of construction, not a large surplus, but a safe one.

In corroboration of the estimate of 10% for general overhead, Foster on Valuation, says, on page 21: "The sum of all the items that "could be counted as overhead charges in the twenty-five million dol- "lars spent for the equipment of the New York Subway amounted to "less than six percent. This included interest during construction, in- "surance, engineering, taxes, and all contingencies. It is time for engi- "neers to bring forward actual figures for these items, actual expendi- "tures for overhead charges, for at present they seem to be far too "high—even those offered by the most experienced engineers. As a 7751
"matter of fact, it is found that in a very few new projects are ac- "counts so kept as to reveal the overhead charge."

Foster also cites the overhead charges as determined by the books and account of the original cost of railroads in the State of Washington, covering about 3,000 miles of line. The overhead, excluding interest during construction, varied from 3.83% to 7.65%. These included engineering, general expenses, legal expense, insurance, interest on advances, bond expense, taxes, and undistributed accounts.

Professor Cooley and his staff set the following percentages for overhead charges in valuation of Michigan railroads:

Engineering	4%
Legal	0.5%
Organization	1.5%
Interest	3%

Deducting the interest charge, this would reduce the 6% which corresponds to my 10%.

I would cite also that in the San Francisco Gas Case, now pending in the Railroad Commission, involving the valuation of approximately $12,000,000 worth of gas properties, the City and the engineer for the company agreed to 10%, calling 6% engineering and superintendence; 4% for organizing a construction force, delays in shipments, excess freight, inclement weather, casualty insurance, and piece meal construction. These last items are not expressed as I have expressed them in this analysis, but mean about the same thing, as I understand it, with the exception that a small percentage should be added for general administration and taxes. I also note that the 4% allowance for delays in shipments, construction organization, excess freight, etc., is practically taken care of in my unit costs in the Spring Valley reproduction, as I have figured on a contract basis for construction. It would appear, therefore, that my allowance of 10% is somewhat in excess of this agreed figure when it is placed on a strictly comparative basis.

7752 This memorandum sets forth briefly my views on the matter. Of course, a great many estimates are made in a great many different ways; if an estimate is made in considerable haste, and in small detail, there are cases where a larger percentage should be added to cover these items, because the contingencies of omission are increased, and so it is not improper with certain kinds of estimates to add considerable more, but an estimate made in such detail as this is requires more than 5% to cover contingencies, and these similar items, etc., of engineering are not as carefully made as they should be. The big item for contingencies is sometimes made where the estimator is very much in doubt about the price the work can be contracted for. A man estimating in a country where he is unacquainted would be entirely right in adding a larger amount for contingencies.

While I do not understand all of the local conditions in the East, it seems to me that water problems would be ordinarily simpler here
7753 than they are in the populous districts in the East, and therefore the item for engineering should be less here than there. I have never been connected with a piece of construction that had to have a special police force. It is a new item of expense to me.

Mr. Ellis: We never police any construction work. I have had big construction gangs, and if they were a little obstreperous, we usually swore in all the head ones as deputy sheriffs and handled them ourselves.

Questioned by Master.

Mr. Dillman: The interest varies in the different cases. I think the highest interest that I have allowed is 7½%, which is reckoned on 3 years construction, and the interest on the whole amount for half the time, or half the amount for the whole time. I have used 10% throughout, and have adopted varying percentages for my interest,

according to the length of time during which it would be under construction.

Witness: J. H. Dockweiler for Defendants. Dockweiler

DIRECT EXAMINATION BY MR. SEARLS. 7754

Dockweiler's overhead introduced and marked "Defendants' Ex-"hibit 157".

My total overhead comes to 21.9%, which includes interest during construction; administration 3%, engineering 7%, insurance 1%, interest during construction 9.9%, and taxes 1%. Those add up to 21.9%. That is resolved; by taking 9.9% of the total construction costs, you get the allowance that I have made for interest. The interest is 8.9%, computed on the 111%, but I have just added them together and called it 21.9%.

Contingencies; no allowance was made for this in general overhead—I refer to the allowance of 25% that I have made as I went along—because it is fully covered in my allowance in figuring unit costs, contractor's profit. The figuring of 7% is obtained as a matter of judgment, based largely on a study of the engineering costs in the Los Angeles Aqueduct and the San Francisco high pressure water system.

Referring to the second sheet of "Exhibit A"; this is a copy of 7756
page 2 of Mr. Clemons' report, termed "General classification of ac-"counts". The first sheet shows my deductions from that. The second sheet is the one on which the aggregate of the figures in the column is $24,526,868. That sheet is a verbatim copy of the second sheet of Mr. Clemon's report. The first sheet of "Exhibit A" is my resolution of that $24,526,868. Waterway construction is given by Clemons as $15,942,489. The items which Clemons would classify as 7757
indirect, or in addition to the waterway construction, I have included in my unit costs, sanitation and housing, $197,330; warehouse expense $206,840; water supply $444,425; roads and trails $308,632; building $336,531; telephone lines $150,753; low tension power lines $59,240; equipment expense $1,548,771; miscellaneous $457,489. Sub-total, base cost, comparable to my method of unit costs, $19,652,450.

What I take from the Aqueduct to be engineering is an item 7758
marked "Preliminary engineering $399,588", then an item "Division "administration $371,242, an item, tests of pipe, etc., $39,167, and "general expense, $701,600." These total $1,511,597, which, divided by the $19,652,450, equals 7.7%, which is comparable with J. H. Dockweiler's Spring Valley item of 7% for engineering. Now, general expense not chargeable to waterway by Clemons, is $113,744; I have a separate amount for taxes, so I exclude that $28,600; it comes in under taxes, and did not belong in engineering. Lands and rights of

way, Clemons, $1,558,782; cement mills and land, $883,115. We bought our cement, so we don't have any trouble with the cement plant. Joint waterway power bureau, $750,000. This figure, $750,000, I resolve that in a way, assuming that it is an arbitrary charge which the Aqueduct took over. If it is a part of construction, it ought to have been added to that $19,652,000, and would have brought the rate
7759 of engineering down, but not knowing differently what to do with it, I have put it in as part of the power bureau. If it is construction, it reduces the rate percentage for engineering. Reorganization, I deducted that, $28,580, so that makes the grand total of $24,526,000, which Clemons figures as the cost of the Aqueduct.

Referring to the third sheet of "Exhibit A", detail of general expense. That is a sum total of $843,944, which appears on the preceding page under general office or executive expense. Clemons has subdivided that into two classes. An amount applying to the waterways, and the balance I presume he allows for lands and water rights. I have deducted $28,600 from that $730,200, which latter he says is a charge to the waterway, for taxes, and that makes the figure of $701,600, which I have put in to general expense under my heading of engineering, from which my 7% was deducted. On "Exhibit A", deducting from $730,200 the sum of $28,000, for taxes, gives you $701,600, and then on "Exhibit A" that is the fourth item under "General expense" of the total of $1,511,597, which is charged to engineering.

7760-7761 I have not included in the engineering here any charges made for general administration, of which I have no data; in my overhead I have allowed 7%; then I have allowed 3% for administration, and 1% for insurance. All of my overhead amounts to 21.9% of the reproduction cost, no matter what arrangement you make with it.

Referring to "Exhibit B"; those figures were obtained from the records of the City Engineer in San Francisco. On the bottom of the exhibit is the total cost of engineering and construction paid by the City, which includes the amount paid to contractors, etc., for the engineering, and out of a total of $5,607,092, the engineering and superintending and planning was 7.4%. That covers the reservoirs, the tanks, the cisterns, the fireboats, the pump stations, the buildings and equipment, the intake tunnels, the pipe yard buildings, the grading equipment, the high pressure mains and appurtenances, purchases of materials, construction of the mains, unloading, stowing, and handling pipe at the yard, and plans and miscellaneous overhead. It also includes the preliminary plans and estimates for this system. It includes everything charged by the City Engineer. The engineering
7762 plans and office expense—everything—amounts to $204,000. This work was built by the City of San Francisco, but I have not the segregated items for the preliminary engineering.

7763 Mr. Searls: It is customary in the making up of the costs on

all the city work to charge the pro rata of the City Engineer's office expenses to the various bond issues to funds that are set aside for construction; for instance, in the case of the Municipal Railways, a bond issue is voted, the bonds are issued, and all those employees of the City Engineer's office who were engaged on that work have their salaries, and the drafting expense, and incidentals, charged to that bond issue, and they are paid out of it. I presume Mr. O'Shaughnessy's salary is not included in these figures any more than as Mr. Hazen states Mr. Mulholland's was not. The work of the City Attorney's office would not be included, nor any of the other executive officers of the City. The time of men like Mr. Hunt and Mr. Ransome are charged to the job; all those in the office who assist on the job are charged to the job. I happen to know that Mr. Ransome's salary was paid out of the bond issue of the Municipal Railways. 7764

DIRECT EXAMINATION BY MR. SEARLS.

Mr. Dockweiler: The City built 44 different sewer jobs, which totaled \$2,776,989. That was the total amount expended by the City; 7.3% was engineering, plans, inspection and superintendence. That was subdivided 3½% plans, inspection, etc., and 3.8% that we have segregated. I was informed of that figure on the Municipal Railway charges, but I have forgotten it.

Taking up general administration, on the first page of my memorandum; this is an allowance made on my judgment, and it amounts approximately to \$450,000. It is to cover 5 years estimated construction, and averages \$90,000 a year, and covers the general office, the law department, automobiles, rent of quarters, stationery, light, telephone, and miscellaneous incidentals to a corporation's office. The 3% amounts to \$450,000; my reproduction cost is about \$15,000,000, and you add 3% to it. That is about \$450,000 for administration. That is not my depreciated cost; that is direct depreciation.

The insurance I took at 1%; that amounted to about \$150,000, which is the insurance that a company, in my judgment, ought to have to protect itself generally; that is purely an estimate. I have not any details or studies of why I allowed it, but I put it in, and in my judgment it is a reasonable figure. That does not include insurance paid by the contractor. This is separate for the company to protect its own property. 7765

Interest-during-construction as a weighted average comes down to 8.9%, but just figuring it as one item, it appears as 9.9% in the total, making it 21.9%. I have assumed an average of 5 years for the completion of the work, and I took a 6% interest rate. I think the company starting in would not have as good a credit as one now, and I would say money would cost them 6%. This item is a weighted average of the interest figured on each of the items in my schedule.

Questioned by Mr. McCutchen.

My total interest is 8.9%, but, for instance, adding them all straight through, you take engineering 7, general administration 3, insurance, 1, and applying 8.9% interest on that sum as going to make up the total of 21.9%, it would figure out the interest as 9.9%.
7766 In adding them all up in a column, you get a total of 21.9%.

Questioned by Master.

At page 17 of my appraisal, which is the end of the appraisal of the San Andres Dam, I add engineering and contingencies 11%, and then to that I add interest and taxes during construction 20½%. That means I will be paying interest for three years at 18%, and taxes 2½%. I start one dam in 1910, and finish it up in 1911, so I can have some water in the reservoir, and I am ready to start my system on December 31, 1913. In my next item, the Davis Tunnel, on page 19, my interest during construction is 3%, because I could build that tunnel in one year, during the year 1913. It takes a year to build, but your interest on the full cost is running only one-half the time.

7767 I proceeded on the theory that the works would not come into use until December 31, 1913, and hence, I had to arrange such a program that at midnight of December 31, 1913, I had a condition of a town which contained all the consumers who confronted these works at that date, with the services all made to the distribution pipes, and on the moment, by the turning on of the cocks, everybody was supplied with water. That is where, logically, the theory of reproduction leads you to. You are reproducing it as of a certain date, and if you do not have that condition, why reproduce these works? If you are going to put in units as they are ready, why not have it as the historical method, going back to 1858, when you first started in? You have either got to reproduce it historically, or reproduce it on the moment; reproduction as of a certain time. I disagree in principal with Mr. Metcalf's assumption that he would put in Lake Merced. Lake Merced obviously could not supply all the customers. Where is he going to lay his pipes? Where is he going to put Knob Hill? Is he only going to build a little part of the distribution system. Under the theory, as stated, you have either got to build it by stages historically, or you have got to assume a works ready for services on a certain date, and that means that you have got to carry your interest charges up to that time, and that on that date you have the customers which confronted the system actually ready to be served; you have no long costs of building up the business, because they are there in contemplation, everybody ready to be served, with all of these 70,000 taps.

DIRECT EXAMINATION BY MR. SEARLS.

I have attempted to get an approximate date at which to commence the construction of these various items, so that they would

all be brought into service by December 31, 1913. Such a process is 7768
only approximate, and the individual items might vary, but the average percentage will not be exceeded; for instance, the first thing I have to build in 1909 are my Peninsula roads. Then I install my telephone lines in that year. Then I get my electric transmission line, and then I install the buildings at Millbrae Pump Station, which is my material yard, and proceeding under that theory, I have laid out a plan of construction to bring about the fully constructed system, ready for service on December 31, 1913. I assumed that the city distribution system will require three full years to construct.

Questioned by Mr. McCutchen.

I would lay out my yard at Millbrae, and construct my buildings there. I allowed at Millbrae, buildings used during construction, 12 months. This building would be built on my theory about five years before the plant was able to supply water, and they would have four years full interest on the buildings. I took an average interest for the Millbrae Pumping Station at 7%. The first buildings at Millbrae are relatively a very small amount of construction costs, but I took an average interest rate of 7% for the Millbrae Station; it only takes a year to build that Millbrae Pumping Station.

After erecting this building at Millbrae, and laying out my yard, I would start in on the San Andres Dam, and then I would start in on the Crystal Springs Lower Dam; begin them in 1910. The San Andres I would commence in the beginning of 1910, and you can get the 1912 and 1913 water. I would have the dam ready 7769
so that I could store water for two years, but I would not begin to supply water from that reservoir until four years after I commenced the construction. The interest on that San Andres was 18% average. You begin it in 1910 and finish it in 1911; you have a three year rate of interest on that, 18%. These works are not comparable to the New York works; in the underground tunnels in New York there is nothing comparable to them on earth, long drives, and uncertainty. There is a great big tunnel syphon under the Hudson, and there is nothing comparable in difficulty in carrying on that work to this work here; it is compartively simple. It is engineering of high order, but you can do better and more work here than you could back there.

Take the achievement of the world's fair here, every building of the fair was ready on time, and the East never did that, every exposition was late and delayed. These chaps here on the Western Slopes can get the results. They have had all of these difficulties. I did not go over that work much, but I went down in the big shaft 7770
and noted the work at the Kensico Dam, and I was amazed at the trouble and the details to which they go. To give an instance, at the dam they had a section in different treatments of stone of a complete parapet of the Kensico Dam built on one side; different

treatments of it. They spend all of that money in preliminary investigation. No such investigations are made here. Their work was in bronze, fine trimmed stone work that required most expensive details and experience. There is not anything like that here.
7771 I am astonished that the charges for engineering were so small on this Eastern work, relatively to the difficulties and the pains taking labor that was put in. It confirms me more fully that I have been reasonable in my allowance comparing it with work that has been done here.

DIRECT EXAMINATION BY MR. SEARLS.

Mr. Dockweiler: I assumed the taxes would run for one year; in other words, if a structure is in existence three years before coming into use; that is if it is started three years I assumed it would pay taxes for two years. I figure that an assessor would not become fully cognizant of the fact that it was a structure until it was pretty well started towards completion; that is experience. I took the taxes to be 1%. For instance, here is where I take three years interest charge on San Andres Dam; I allow taxes 2½%, and I assume taxes 1% per year, and I think it could be taxed for about two years on an average before coming into use.

Mr. Metcalf: We segregated Mr. Dillman's figures upon overhead and interest during construction in order to get a comparison with our own. Our figures indicate that the overhead allowance was 9.99%, or 10%, which he stated, and the average interest-during-construction allowance was 5.82%, which is applied to the unit costs, plus 10%, which makes his total overhead and interest-during-construction allowance 16.3%, which figure is comparable with Mr. Dockweiler's 21.9%, and our figure of 28.8%.

7772 Questioned by Master.

Mr. Dockweiler: In the case involving the year 1914 I would just start my construction a year later. I am assuming that it will take five years to complete the plant previous to any given date.

ONE HUNDREDTH AND SEVENTH HEARING. MARCH 1, 1916.

Witnesses: ALLEN HAZEN for Plaintiff.
LEONARD METCALF for Plaintiff.
GEO. L. DILLMAN for Defendants.
J. H. DOCKWEILER for Defendants.

7773 (Certain corrections noted in the transcript.)

7773-7774 (Mr. Metcalf and Mr. Searls advise that the item of discount and cost of marketing securities is eliminated from overhead, and considered in the rate of return.)

Mr. Hazen: The item that I referred to as Treasurer's expense I do not think of as discount on bonds, but the expenses of the Treasurer's Office would be one of the expenses of the whole business, and that was not reflected in any of the figures which I had. I intended to include it, but I did not have it in the data. I could not tell you just what ought to be allowed on that. On the question of bond discount, that would come in in the rate of return.

(The item of preliminary expense of incorporation and promotion, which is not preliminary engineering, was included by Mr. Metcalf and Mr. Dillman.)

Mr. Hazen: I have no experience with those items, and do not know what they would be. If they were not too much, I would try to get them in the 15%. If they came to any considerable figure, I do not think the 15% would cover them. They were not included in the data that I had, but they were included in my overhead. 7775

Mr. Dockweiler: I did not include the preliminary expenses that Mr. Metcalf refers to at page 7660 of the transcript, where he says: "At the inception of any quasi municipal or corporate project, a general investigation must be made of the business possibilities, the local and municipal conditions and environments. A preliminary engineering report is made after examination of the local situation. Legal advice is obtained. Options must be taken upon properties necessary to the execution of the project; franchise and other necessary rights obtained. Organization must then be perfected, incorporation papers prepared and filed, and the project must be promoted in order to interest capital and make the necessary financial arrangements."

Witness: Allen Hazen for Plaintiff. Hazen

Mr. Hazen: As far as that 15% is concerned, and the question whether that includes any promotion or organization expenses, I think the figures that I have fully substantiate the 15%. I think they would substantiate a figure a little higher than that without any allowance for promotion and organization expenses. I should say that 15% might fairly be considered as excluding that. I really do not know what those expenses would run, or what ought to be allowed. I think it is a fair statement that I have practically disregarded that when I made up the estimates. The preliminary engineering investigation I intended to include. I am in a position to include this because I have had a great deal of experience with that, and know what it involved, and what is often spent. 7778

CROSS EXAMINATION BY MR. SEARLS.

I fixed that preliminary engineering at 1%. I did not think it was necessary to separate the matters that went to make up my 15%.

7779 They will vary in every job that is carried out, and as long as I have based this statement on actual experience solely, and in my judgment representative experience and comparable experience, it seemed to me that the total was more significant than the division. The figures which I presented do show the divisions, in part at least, for the cost that I cited; those figures speak for themselves. I might have considered some distribution of this overhead among the various elements which are ordinarily classified separately, but I did not think it was any better way, or as good a way as the way I used, and I actually did not do it. I would rather not, at the present time, attempt to give you offhand any separation of the 15% into percentages chargeable to engineering and to overhead.

The Spring Valley works I have said on my direct examination were very well engineered. I did not make any special study of the organization which was actually used by Mr. Schussler in constructing the main units of these works. I should not say that a very elaborate engineering organization would be necessary in a reconstruction

7780 of the works as they stand today, because I do not think a very elaborate engineering organization has been had on the works that I have cited, but the organization certainly would more nearly be comparable to that used on the work that I mentioned than to the organization that was used by Mr. Schussler; that would be necessary because these works would be built in a limited time. Mr. Schussler worked on the development of the Spring Valley system for a lifetime, and Mr. Schussler, and the organization he had, in my judgment, would be wholly unable to handle all the work involved in the construction of this system in a period of 5 or 6 years.

I would say that as far as the proposition of working a large number of men a short time, or a small number of men a long time, goes, the position is sound; in other words, if there is, for example, 5% on the Crystal Springs Dam devoted to engineering, resulting in a certain corps of engineers and assistants, etc., and 5% on the pipe lines simultaneously, and 5% on something else—in other words, 5% on the whole structure, you have an organization multiplied as many

7781 times in amount. One of the objects in having good engineering, and it is an important object, on the construction of waterworks, is to reduce the overhead. In other words, to prevent the piling up of contingencies and needless expense.

The engineering ordinarily means the technical control of the work, and that affects everything else. It affects the unit prices; it affects the quantity of materials; it affects the excellence of design; it affects the quality of materials; and it affects the extras and contingencies; it affects everything. If we take the engineering on the

7782 Spring Valley work as 10%, and you have a certain result, and supposing you try to cut our engineering outlay in half, what is the result? Instead of spending $100 on construction, you might spend

$120 or $130, or $150. In other words, you would build structures not well adapted; you will have more unit quantities; the unit prices may be more or less, because with poorer engineering there might be less good quality, and there might be a cutting of prices to correspond with it. I should expect, with cheaper engineering, that you would have poorer structures, and that they would cost more. It is my inference that the Spring Valley structures, as they stand today, were well engineered, and as far as I know, the engineering was done principally by local men here. On the New York jobs which I used by way of comparison there was no undue haste of construction; they were pushed as rapidly as was regarded economical and advantageous. I can give you a little idea of the organization of the engineering force on that project. The whole work is in charge of a chief engineer. There is a board of consulting engineers, and usually there have been three men who have gone over all the plans, and approved all of the 7783
work in its preliminary stages. Those men are Frederick P. Stearns, John R. Freeman, and William H. Burr; afterwards Mr. Alfred Noble became a member of the board. He died later.

Then there is another line of consulting engineers, of which I have the honor to be one, who are responsible, not for all the work, but only for some parts of it, particularly referred to them. Under the chief engineer there are a number of departments; there is a headquarters department which has charge of the general investigations and designs, and then there are other departments that have charge of the principal divisions of construction. For instance, the White Plains Department includes a certain section of the aqueduct north and south of White Plains, and the Kensico Reservoir, and the Hill View Terminal Reservoir each department has a certain district or territory of the work. Under the department engineer there are division engineers, and each division engineer is the resident engineer for work of one of the subdivisions in that department; each division is intended to cover as much work as one resident engineer can personally take care of. The division engineers have assistant engineers, instrument men, inspectors, and all the people that are necessary to perform the work that has to be done. The number of special engineers of the class in which I find myself, has varied somewhat on that work, but there are approximately six. I handle the sanitation end, and the quality of the water, and some other things. The branches 7784
which these special engineers shall handle are not very closely defined. In any question that comes up that Mr. Smith thinks that I can help him about, he asks me about, and the same with the others. I am not responsible for the work beyond the particular advice and information which I give. One of the other men has the architectural features and landscape features of the work, and one of them has the geological features. Mr. Fuller has also served in somewhat the same capacity that I have done, and many matters have been referred to the

two of us, jointly. With due modesty I should say that the best engineering brains of the country have been called into the consideration and direction of those projects. There were difficult features in handling that project, but I do not know that I would say that they were unusually difficult, considering the magnitude of the work.

The conduits were of a larger size than any that had been designed for municipal works in the country, and they had to be carried under two or three rivers. A village was moved for the reservoir. I would not say that the system was built in a very densely populated state.
7785 The whole country in which the works were built is no more densely populated than the country some distance out from San Francisco, and the land, on the whole, is less valuable. For instance, on the Little River plant, which has been mentioned frequently, we bought most of the land that was required at $10 an acre, and I presume that was twice what it was worth. I do not think that relatively there were much larger communities to be dealt with there than you would find in constructing the Alameda County half of the Spring Valley system. Of course, the New York system is a large system, but it goes through wild country until it approaches New York—of course I will except that as it gets into the city, and part of Westchester. It starts in the Catskill Mountains. This little village was moved, it is true, but I think the cost of moving that was charged to the land de-
7786 partment rather than to the engineering; at any rate, it did not take much engineering to get rid of the houses after the property was bought. The line goes down, for the most part, through a wild, mountainous country. It does not hit any towns. It hits some farm land here and there, but the farm land is not worth so much per acre as the farming land outside of San Francisco.

You might classify the suburban portion of New York City through which it passes as from White Plains in, from the Kensico Reservoir; half the distance from the Kensico Reservoir into the heart of the city is through practically unoccupied land, but land held at prices anywhere from $100 to $1,000 an acre and upwards, because they expect to sell it off for suburban lots some time. Of course, as the city is approached, the land gets more valuable, and the population increases, but very much the greater part of the line that part of the way was on city property which had already been acquired, and so there were no special difficulties involved in that. There are addition costs involved in traveling through densely populated sections, even where you own a right of way, certainly, but they are always in the day's work. I do not think they are any more in proportion than laying pipes through San Francisco. The laying of pipes
7787 through San Francisco does not involve the same kind of problem as building the conduit into New York, but it is just as difficult a one, relatively. All the conduit in New York City is a big hole in the ground, lined up with concrete, and a few extras. The ordinary diam-

eter of the present aqueduct is 17 feet, and the ordinary diameter of the Croton Aqueduct, which preceded it is 14 feet, so the increase in size was not very radical.

The problem we had in New York has points of similarity to the 7788
driving of a tunnel, but it has a great many points of difference. I think it is more comparable to the pipe system, because the tunnels that were driven in New York for the backbone had a great many miles of large pipe that were laid in connection with the tunnels, to take the water from the tunnels to the smaller pipes in the streets, and that is certainly more comparable to the street work in San Francisco than to the tunnel work in San Francisco (Twin Peaks).

There was no tunnel work involved in the construction of the
distribution system of the Spring Valley, outside of driving the Bernal 7789
Tunnel, and some of those other tunnels through the hills. There were some tunnels outside of the city for bringing in the water. The conduit in New York is not a subway at all; it is a pressure tunnel, and it was driven as a pressure tunnel. The only added cost of driving it through the city is the added expense of disposal of material that is taken out, and the added expense of getting the cement, etc., to it, and that is quite an element.

I should not think, as a percentage, that as the width of the trench increases, or the size of the trench increases, that the engineering and overhead element would necessarily increase. I did not pretend to separate the overhead data so that I could tell just how it would vary with each structure. I have not tried to do that, but have considered it rather as an average on large systems. I should say that my percentage of engineering in New York with its congestion and large size of works would not be larger than with San Francisco.
I should say the percentage, as nearly as I know, would be the same 7790
for a corresponding grade of work. The driving of a pressure tunnel requires good engineering, but I do not know that it requires better than other parts of the system.

Questioned by Master.

A subway is ordinarily a structure that is built cut and cover in the streets. That is the way our subways in Boston and New York have been built. This pressure tunnel simply refers to the fact that it is used under pressure, and that the lining and bank has to be better built than they would be simply for a concrete tunnel; that is the only difference, and it is a minor one; it adds something to the expense, but not very much. The only peculiarity of these tunnels under New York City is that they are driven several hundred feet below the surface; they had to be driven through shafts, and this material all has to be hauled up and disposed of, and some drainage is necessary, but the water encountered has not been large, so that except for the extra expense of getting the material up and disposing of it, all the tunnel work is exactly the same, other things being equal, as

it would be in driving a tunnel at Sunol. There was no caisson work in getting it under the river. I think there was a little compressed
7791 air on one of the minor crossings, where they struck a bad place, but with that very minor exception, I think no compressed air was used on the work.

In the Boston water supply there was a village that was submerged by the Wachusetts Reservoir, but otherwise, the area involved was a sandy upland area of what I should call scrub country, not good enough to have real forest on it, not good enough to be good farming land, and carrying a small rural population. Spot Pond, which I think you are referring to, Mr. Searls, was a natural pond which was taken by the Metropolitan Water Board and raised and cleaned and improved, and used as a distributing reservoir. Incidentally they paid some $900,000 for water rights when they took it.

The organization on the Boston Project was quite similar to the New York, although smaller, because it is a smaller piece of work. Mr. F. P. Stearns was chief engineer, and Mr. Fteley, and Mr. I. P.
7792 Davis were the consulting engineers, and in addition other engineers were employed from time to time on special problems, and I was included among the number. There were various department and division engineers, and their assistants. I don't know that there were any problems that were more difficult on the Boston Waterworks than on others. There are always problems of especial difficulty on every large waterworks system. Mr. Hiram F. Mills acted as consulting engineer for the Wachusetts Dam, and had a good deal to do with the work. Mr. Fteley, I think, died before the completion of the work, and Mr. Davis became associated with the American Telephone & Telegraph Co. There was an item for policeing on the Boston system, and there was also an item for policeing in connection with the Springfield works. I think the necessity for the large expenditure for police on the New York Project was brought about by the fact that the local police were unable to handle the large construction crews that they had. It seemed necessary to have a certain amount of police super-
7793 vision to keep the men in order and keep peace between the men who were doing the work and the natives. I think the method that Mr. Ellis described, of swearing construction superintendents as deputy sheriffs is inadequate on a large piece of work. For one thing, the principal duties of the police are after the work stops, and I do not think that you would want your superintendents sitting up nights to see what the employees were doing. I think it undoubtedly would be necessary to have some special police provision to handle the construction crews in a reconstruction of the Spring Valley system. I have no record at my disposal to determine that such a provision was made in the construction of the system in the past. I could not say whether there was a police expense on the Los Angeles Aqueduct, or not.

In all of these cases the police have only been put on when there 7794
was some reason for it; they have not been put on at the start, anticipating trouble. When you have large construction camps, and men are brought to a place that is not their ordinary home, and they work short hours, they have a great deal of time to get into trouble. The only way that I know that you can keep peace in the community, and not get into trouble with the local people, is to have a certain force to keep them straight. On the Panama Canal I know that the police force was quite highly organized, and was an important part of the work.

Questioned by Master.

I do not include watchmen in that list; that would be taken care
of by the contractor. I don't know whether there was a separate 7795
police organization on the Cincinnati work or not. We had no police organization for the Springfield work, but we found it necessary to get the police of Westfield, the adjoining town, and to have them assign special men to the work, and we paid their salaries. There was quite an item for policing in that way.

Questioned by Mr. Greene.

The necessity for policing increases as the size of the work increases. Of course, a great deal of the work we had to do with has been in the limits of the city on whose account the work was being constructed, and the ordinary police force would take care of anything that was necessary to be done, and so far as expense was involved, it did not come into the cost of it.

CROSS EXAMINATION BY MR. SEARLS.

I think the longer you could work the men, the less need of police 7796
there would be. I think that has some application in comparing the records of recent work where the 8-hour day has been used, with the conditions on work done a good many years ago where the 10-hour day was in force. There is more opportunity for disorder in the latter work than in the former; I think it is there.

Mr. Metcalf: This item of policing in the New York supply work was about 2.18%, I believe, in the percentage of overhead. That was based on \$99,000,000 worth of work. The total overhead, comparable to my 13% overhead, was 14.56%, excluding about ½% for preliminary engineering.

CROSS EXAMINATION BY MR. SEARLS.

Mr. Hazen: My administration charges on the New York work of 1.26% included the administration for the whole period, from the time that this board was appointed, until the first of January of this
year. I have the amounts for the work that was handled under these 7797
administration charges for each year, and the totals were as follows: For salaries, \$1,139,616; for equipment, \$35,332.86; for consumable

supplies and expenses, $259,521.47. That covers the years from 1905 to 1915, 11 years. I think I reckoned my administration of 1.26% on the whole of the disbursements.

Mr. Metcalf: I think, Mr. Hazen, that was based on $113,-862,000.

Mr. Hazen: $113,861,751, that being the total payment for construction and land, with estimate of work done on force account added; in other words, that was figured on the whole amount spent for construction, and the whole amount spent for land without the overhead. I think that percentage is probably too low to use for the Spring Valley.

7798 Questioned by Master.

I think that 2.18 would be enough for policing on the Spring Valley. I think it might be done for somewhat less than that. The administration for building the Spring Valley system, I should think, would reasonably be somewhat more than that, because it would be a smaller piece of work. The land problems, I think, in the Spring Valley system would be much more complicated than they were on the New York system.

CROSS EXAMINATION BY MR. SEARLS.

This is general administration, and I took that pro rata for the construction and the land. I don't know why that is not as fair as can be done. All the expenses directly relating to land were charged to the land account, and all the expenses directly relating to construction were charged to the construction account; these are the salaries of the commissioners and the secretary, and that sort of thing, that there was no direct way of dividing. I should not know how to divide it better than pro rata. Of course, with the greater difficulty of acquiring the land, if they were greater here on the Spring Valley system, that would add to the direct cost of the expense of acquiring the land. It would add to that rather than to administration. I don't know that it would add to the percentage of administration; I may have spoken too quickly on that. The reason for increasing the percentage for administration here over that
7799 used in New York, is principally because it is a much smaller piece of work. It would require a somewhat smaller organization, but I think there would be a tendency for the administration to be a higher percentage with the smaller piece of work.

I am somewhat familiar with the present administration of the Spring Valley Water Co. I don't think the present general organization of the Spring Valley would be sufficient to handle the construction of a system of this kind in a few years. As to what departments of general administration would be increased most is getting down into pretty small particulars. I don't know that I can tell you right off. There would be a great many things to be con-

sidered. The engineers have to be selected and looked after; that is the greatest responsibility of the administration, and it is a great responsibility. Then, the policy with regard to acquiring land and rights, what shall be done, discussion by the engineers of all the matters that come up, the negotiations with the public and the corporations that are met in connection with the work; it would certainly involve an amount of business for which there is no comparison in the present Spring Valley organization. I will assume that the ordinary operation business would not have to be handled by 7800
this force, and I will assume that you would not have the operation until your plant was built. For interest-during-construction I assumed a maximum active period; I assume that the whole period of maximum construction will be somewhat more than five years, with interest reckoned on somewhat more than two years, that there would be a preliminary period of preparation in which the percentages would be compartively small. The actual length of the construction period on the aqueduct in New York was 11 years, and they had a total interest and taxes during construction reckoned on a basis comparable to the Spring Valley, of 18.02%, which is the actual rate. On page 2 of my exhibit is the computation of what it would be at 6% rate comparable, and it amounts to 25.15%. That covers an average of 4.19, the total being 11. There are 3.4 years covered on my Boston Supply.

The reports of these systems do not deal with interest. This 7801
report, for instance, has the details of all the expenditures, but the interest is paid by the City Comptroller. The Board of Water Supply has nothing to do with it, so, therefore, the calculation is my own. I took the dates when the payments were made, and the amounts of the payments as shown by the Water Board Auditor's report, and applied to those the rate of interest which I found from other reports of the city bonds. The line which shows the average number of years for which interest was paid is my own calculation from the data.

For instance, to take a specific case: For the New York Board of Water Supply, the total interest is 18.02% on the structures; the computation of that is found on page 8, where the amount of the payments for each year is entered, and the factor by which those payments would be multiplied to bring them to the date when the first water was used, and the product, and then those are both added up, and the latter is 18.02% more than the direct payments. That 18.02 is divided by 4.3, the rate of interest, and that gives 4.19 years. That is an approximate calculation. The effect of compounding is 7802
overlooked in that division. If the effect of compounding were taken into account, it would be 3.94 instead of 4.19. To get that factor on page 8: Beginning with the payments for 1915, I multiply those by 1.0215, which is six months interest, at 4.3%; the preceding item is

multiplied by a factor which is the interest for 1½ years compounded. That is the way we always make these calculations, and we think it is a fair way to make them. The interest is paid on interest just as much as on the principal as the work proceeds. If the money is borrowed to pay for the work, and they would have to pay interest on it during the period it was being used, they should be entitled to earn interest on that interest. The interest has to be paid.

7803 Let us take a specific case: The money spent in 1905 was $118,000, leaving off the fractions; they would pay 4.3% interest on that, which amount to something. Now, the next year, considering this $118,000 only, they pay interest on that; what is going to be done with the amount you paid in the preceding year for interest? It has to go somewhere. Who is going to pay that? I treat it as part of the company's outlay, and as such it carries interest until the whole structure is completed if interest is paid before any revenue is earned by the structures. Consequently, the interest should also carry interest up to the time the structure goes into use.

7804 One reason I selected these four plants was because the work was done by an independent commission, and there was no mixing up of their accounts with the general city accounts. That I consider very important, because, from my experience in doing work with cities, it is very rare, indeed, to be able to get all the accounts when one gets through, so that one can tell the whole cost of the work; cities do not keep their accounts so that that can be determined.

RE-DIRECT EXAMINATION BY MR. GREENE.

It seems to me that, taking the work right through, the New York work, and the work that would be involved in reconstructing the
7805 Spring Valley plant, is a pretty fair comparison. That the difficulties in one case, so far as I can tell, are proportional to those in the other. It seems to me that a comparison from one waterworks system, including all the classes of structures that go to make it up, is much more to the point, than a comparison based on a part of a plant, one particular kind of structure, and especially it is more to the point than any comparisons drawn from other kinds of engineering structures, for instance, railroads or subways. I don't know anything about those, and I don't know whether the engineering is the same or not; I have had no experience, and I should not give statistics of that kind much weight. I would look for waterworks systems. In general, it is true that the special difficulties in one situation will not be the same as the special difficulties in another. If they were the same, the business would be standardized, and on a very different basis from what it is.

7806 A good many years ago I was a student of public water supplies in Europe; I spent a year visiting a great many of the important supplies. At that time, the water supply business in Europe,

especially in Germany, was a long way ahead of what it was in the United States. Almost everywhere that I went, people asked me if I knew Herman Schussler. He seemed to be about the best known American engineer in Europe. He knew the men over there, and knew what they were doing. Now, I learned from Sollbach, who was, perhaps, the best hydraulic engineer in Europe on underground supplies, about his work in developing ground waters. It was wonderful work. I never saw Sollbach's principles applied until five or six years ago, when I came to San Francisco, and saw the Pleasanton system. In my judgment, that was the best handled development of its kind I have ever seen in America. It was comparable to Sollbach's work in Germany. 7807

I had not formulated my appraisal to the extent that a man of Mr. Schussler's ability could be obtained to act as the head of the reconstruction work. Getting a man as engineer on a work of this kind is something of a gamble. The older men who have been tried out are often not available, and the younger man who has not been thoroughly tried out has to be taken. There is not any certain way that a board of directors of a company like this can make absolutely sure that they are getting the best engineer that there is. I think it is fairer to assume that they would get good average engineering service, rather than they will get the best. It looks easy, when a thing has been done, to do it again, but when you go to a strange country, where the conditions have not been developed, where nothing is known, where the runoff from the rainfall, even, is not known, and where the underground conditions have not been determined, and block the thing out, and get it so that it will all work, it is a real service, it is not any light matter. It is quite true that when you are considering valuations for rate-fixing purposes, there is some point at which you have to stop speculating as to what might happen.

Witness: LEONARD METCALF for Plaintiff. Metcalf

CROSS EXAMINATION BY MR. SEARLS. 7808

In making up my percentages of overhead cost, I did not have any particular work in mind any more than the general records which I have presented. I suppose my mind was unconsciously influenced by the experience of our office. None of those works included tasks of a magnitude comparable with the reconstruction of the Spring Valley works. I suppose, perhaps, the supervision and the construction of the Louiseville sewers was as large a piece of work as has actually been constructed by us; plans have been made for some others of equal magnitude, or of greater magnitude. That involved an expenditure of something over $4,000,000.

The largest waterworks on which we have had the direct charge of the planning and final construction is the Kennebec Water District, of Maine, something around $400,000, or something over that amount now; we have been called in to advise upon various other construction works, but where we have not actually supervised the construction.

My total construction, exclusive of overhead and of land, was
7809 $267,000. That was simply on the structures. Some additional works have been built there under my supervision since those figures were made up. I would not like to take the overhead percentages on that work and apply them to the Spring Valley work, on account of the difference in magnitude, and also because the scope of the work was not as broad. There were some difficulties in engineering on that work, but no more so than you would expect to find normally. The intake into China Lake proved pretty difficult. On the other jobs on which we were called in, it was more in an advisory and an administrative way. In the Falls Creek work, which was done in Indianapolis last year, the general situation, and desirability of developing the supply, was discussed with me; the plans were then drawn by their engineering department, then they were subsequently submitted to me in conference between their president and their chief engineer, and some changes were made in regard to pipe sizes, and general suggestions made; the work was actually executed by the company. My estimate of the percentage to be applied to the Spring Valley construction for engineering and administration is
7810 based both on my studies of other jobs, and upon actual experience in executing work.

The data which I used from the New York, Boston, and Cincinnati work, was obtained from Mr. Hazen, and used in much the same way that he used it; some of that data was worked up quite independently by us. On the Cincinnati work, and on the Boston work, we worked the data up independently. The matter which I have put in evidence with respect to those projects is based largely upon Mr. Hazen's study, but I also had before me the figures that we had made independently. You will remember that in discussing my exhibit I referred to the difference in the results of my analysis of the interest-during-construction account on that work, as compared with Mr. Hazen's; there was some slight difference; it was not very material. That was the Boston Metropolitan Water Board work. The difference was the final result which he got, the interest-during-construction allowance, which amounted to, I think, 9.42% on his assumption or analysis of the actual rate paid for money, which was
7811 3.1%, where ours was based on 3.16%, as you will remember, and which resulted in an interest charge of 10.3%, I think it was, based upon the assumption that no allowance should be made for interest-during-construction upon the pipe system, except for six months

interest upon the work done during the year in pipe laying. If the interest were carried forward to the completion of the pipe laying, on the other hand, it would increase that amount very materially. I did not take any averages of the figures I have given on sheets 2 and 3 of my exhibit. The engineering in a good many of those cases would run somewhere around 7%. There is no filter work involved in the Catskill supply included in these figures, but some preliminary studies have been made.

I have no records based on my experience in the Denver rate case showing the amount of overhead which was originally figured in the construction of those works, nor did I have the original costs at the time. We tried to get it particularly with reference to construction work which had been done within the last five or ten years, but the segregation on the books of the company was an arbitrary one, which averaged about 10% under their method of accounting.
It varied on the different years very largely, being very high on 7812
some years, when very little construction was done; it was purely arbitrary, and did not shed any light on the problem. I contended, in that case, for an overhead of 12½% on the structures, excluding the preliminary engineering costs, promotion, organization, and so on, which amounted in our contention to about 1½%, and excluding the taxes which we considered in connection with development expense. The basis was just about the same as here as nearly as I can determine it. Perhaps a fraction less than here. The Master in Chancery in that case found a total of 12½%, including all those items. I cannot answer you with regard to taxes, but he did allow 12½% on the overhead, including the preliminary engineering, organization, promotion, and so on.

Questioned by Master.

In this presentation I have included taxes in my overhead. The final 15% includes taxes.

Mr. Hazen: It is my impression that the taxes on the structures during construction would not be very heavy. I am not fully informed as to the local conditions here. My estimate is based on that assumption, however.

CROSS EXAMINATION BY MR. SEARLS.

Mr. Metcalf: In that Denver case, in reckoning my interest, I contended for 8%, and that is what the Master finally adopted. It is my recollection that I allowed there five years, but I didn't figure
interest for five years; that was the construction period, correspond- 7813
ing to the six years here, as nearly as I now remember. The rate of interest was the same there, according to my recollection, 6%. One reason for its being lower in that case, in my judgment, grew out of the nature of the structures; that they could be built within shorter periods of time, wood stave pipe lines, conduits, for instance,

can be built in a shorter time than wrought-iron pipe lines; also the character of the sources of supply, two of which are within the city limits near at hand, which affected my consideration of the problem there, allowing for the interdependence of the interest-during-construction item, and going value, or development expense item. The figure of \$13,415,000 which the Master gave as his award in that case, includes such land as there was. It does not include all of the land, for he eliminated from the rating base the ranch lands owned by the company upon which the water is put to beneficial use when they have no use for it for the supply of the city. His allowance on land was \$637,814. There were water rights also included in that
7814 valuation of \$13,000,000, and they amounted to \$2,947,617, which means about 3½ million, covering lands and water rights, and the going concern value was \$800,000, making a total of about \$4,300,000, which would leave \$9,100,000 as the depreciated reproduction cost of the structures. The reproduction cost new was something over \$10,000,000, including overhead and interest. The value of the structures involved in that system was about one-half of these. That depends, of course, whether you take Mr. Hazen and Mr. Metcalf, or whether you take Mr. Dillman and Mr. Dockweiler, but if you will make a comparison of the valuations of the engineers on the two sides, you will see that it is perhaps a little over one-half. The period of construction, however, was very much more than half of the period that I have used here. If I remember rightly, the ratio is as from five to six years. I have allowed 12% for interest, and Mr. Dockweiler allowed 10%. It was 8.0% as comparable with our figure of 12. My interest calculation for the purpose of getting 12% is 6%,
7815 it was two years in my case.

I considered it from two radically different points of view; one was the broad point of view as to how long a period of time might be involved, taking that at two years, and in forming judgment on that, taking into consideration the experience that had been had in the construction of these other waterworks. Then I made a totally different kind of analysis in connection with the development expense analysis, in which I assumed such a procedure as might pre-
7816 vail in the reproduction of the works, and in that case I cut off the interest immediately that each structure was finished. In other words, if the structure was begun in the second year, and ended in the third year, the interest ceased, according to my computation, at the end of the third year, and it was not carried forward to the sixth year. In that computation, I took into consideration the interest payments which would accrue upon the lands as well as the structures, and treated the project as a whole; then I threw all of the remaining interest charges, which would have had to have been paid, as a matter of fact, until certain of the units went into revenue producing work, into the development expense. I considered those two

alternative points of view as an aid to judgment. They were made at different times, and arrived at certain figures which I used in finally fixing what seemed to me a fair interest-during-construction allowance.

I would not attempt to bring all the units into use at once on 7817
the assumption that my consumers would be waiting to be taken on. I assumed that the consumers would be taken on as different workable units were completed; in other words, that you would begin your operation at the end of a three years period, instead of at the end of the six years construction period, and with that in mind, I would arrange my construction so that revenue producing units would be brought into use successfully and together. In a general way I would extend that to my city distribution system, although in this case I have assumed that the rate of construction of the distribution system would be fairly uniform throughout the period of construction. There would be little utility in constructing the entire distribution system at once, if that could be completed in less than 7818
the full time, because you would not have enough water to fill it, and that is one of the reasons for not assuming that. I can indicate to you, in a general way, the order in which I would construct these units, but not in petty detail: I assumed that during the first two years, including the preliminary investigation, a million dollars would be expended upon the pipe distribution system; that in the third year, the Lake Merced property would be completed; that the work on the Crystal Springs Dam would be begun; a million and a half would be expended on the distribution pipe system; that the Crystal Springs conduit line would be begun; also the San Andres; and that the supply main to Honda would be laid.

In the next year, the Crystal Springs Dam would be still under construction; the Crystal Springs Upper Dam would be completed; the Pilarcitos Stone Dam and Aqueduct would be begun; the San Andres system would be begun; the Alameda supply works would be begun, and on the distribution pipe system again a million and a half would be expended; that the Crystal Springs conduit would be completed, and the San Andres conduit; that the Alameda pipe line would be begun, and the Sunol Aqueduct.

The next year the Crystal Springs Dam would be completed; the Pilarcitos Dam and aqueduct would be begun; the Pilarcitos Stone Dam would be completed; also the San Andres system, and the Alameda supplying works; the Calaveras works would be begun; on the distribution pipe system there would be an expenditure, again, of a million and a half; the Alameda pipe line completed; the Sunol 7819
aqueduct completed; the Central Pumping Station force main completed.

On the next year the Pilarcitos Dam and Aqueduct would be completed; the Alameda-Pleasanton work; the Calaveras work com-

pleted, and the distribution pipe system, the old Niles Aqueduct would be built, the Pleasanton-Sunol pipe line, and the Hadsell ditch.

In that list I have overlooked the pumping stations and the small reservoirs. I can give those to you very briefly, though, if you want them.

The distributing reservoirs would be completed along with units of the distributing system.

The Merced pumping station I assumed would be built in the third year, so that it would be ready for operation in the beginning of the fourth year. In the following year the Black Point and the Precita Valley stations would be built. The year after that the Clarendon Heights, the Ocean View and the Central Pumping Stations, and the Belmont would be built, and the Millbrae begun; that in the following year the Millbrae would be completed, and the Ravenswood and the Pleasanton stations would be built.

That with regard to city reservoirs, in the third year La Honda would be built and ready for service on the beginning of the fourth year. That in the following year, that is to say, in the fourth year, there would be built the University Mound; La Honda would be completed; the Francisco and the Clay Street Reservoirs would be built.

On the fifth year, the College Hill, the Lombard Street, Clarendon and the Presidio Reservoirs would be built, and in the last year the Potrero Heights and the wooden tanks. In general, you see the reservoirs come into service with the various conduit lines supplying them, and with the distribution pipe system.

7820 In general, the period involved in the construction of the pumping stations and the reservoirs is assumed to be about one year, or a portion of a year in the smaller ones, of course; the conduit lines two years. The controlling feature in getting the first unit into revenue producing condition is proximity, and the period which the construction required, and the revenue which you might derive from the construction. Taking the work that I expected would be done during these years, I have suggested the distribution system work during those two years in connection with preliminary studies on other work, and I have suggested, also, the construction of the Merced Lake system to supply the distribution system. You could begin some large unit at the same time, but it is merely that you are building up very heavy expenditures in a comparatively short period of time. I have assumed that a year, or perhaps a year and a half would be consumed in getting your plans and investigations made, and the purchase of the real estate. The purchase of the real estate in this situation seemed to me a very important one, one which would require a very considerable length of time, and that is included in the six year period.

I have not attempted to segregate my 15% for general overhead in detail. I can show to you, in a general way, that the pre-

liminary expenses of organization, incorporation, promotion, and the legal expenses, and engineering expenses that might be attached to that, and I should estimate that at approximately 1% on work of 7821
this magnitude; on very small work I have seen records which have run from 3% to 5%. On larger work the percentage would be smaller. In a general way, I should say that the engineering and general administration would be perhaps from 10% to 12%. It depends so much upon the method of accounting which you use, that I do not feel as if I knew just what the amount of the engineering, as distinguished from engineering expense, was in the records, examples of which I have given you. In some cases one system of accounting would include the costs incident to the engineering work in miscellaneous expenses; in other cases all of those costs are included under the engineering itself; so it is exceedingly difficult to get an absolute line by comparison between the two. I should say that probably the administration might run from 3% to 5%, depending upon the method of accounting, as to miscellaneous expenditures; and the engineering from 7% to 9% on the same basis; in other words, it becomes a question as to where you draw the line on your clerk hire, and the expenses of your office, the telephone system, the rent, automobiles, and all that sort of thing. In the examples I have given, I am not sure which method was used in each so as to be able to separate them. I cannot draw a sharp distinction in the method of accounting. I know it has been different in certain 7822
cases. In general, I should say on the preliminary work it would be 1%; on the taxes, perhaps 1%; on engineering and administration, perhaps about 12%, leaving the miscellaneous 1%; on the other hand, that would require the assumption that in the engineering and administration had been included some expenses which might have been included under other systems of accounting in the miscellaneous expense.

With Mr. Sharon's assistance, I tried to get a line on those costs in the Spring Valley construction, but we were unable to do it. I cannot say that there was anything which indicated that engineering expenses were very high, or very low, or moderate, in proportion to other large construction with which I am familiar. It is my impression that they were moderate.

I think that it is probably true that Mr. Schussler's compensation for his work was less than what he would charge if he were a consulting engineer, doing the same work in five or six years time, and I also think that the compensation which he would get today, were he doing the work today, would be much greater than at the time he did it; that is, the compensation of the engineering, and the engineering costs today are very substantially higher than years ago when these works were originally built; the wage scale is 7823
higher.

Mr. Dockweiler: Mr. Schussler's salary, charged to the Crystal Springs Dam, appears under an item charged as profit and loss. Mr. Schussler's salary from February 1, 1886, to June 30, 1887, seventeen months, was $8500; from July 1, 1887, to June 30, 1888, twelve months, it was $12,500. He received $500 a month for seventeen months, and $1,000 a month for twelve months. George Schussler's salary was charged from February 1, 1886, to June 30, 1888, twenty-nine months, $5800, or $200 a month. Then again, Mr. Schussler's salary, July 1, 1888, to December 1, 1888, six months, at $1,000 a month; Mr. George Schussler six months at $200 a month. So there is charged for the services of Mr. Schussler and his brother a total of $33,500. The engineering paid for on that dam, to the extent that the books of the company disclose the same, totaled $4,950; this was various sums paid to various engineers, George H. Mandell, of the United States Engineering Corps, James D. Schuyler, and to a Mr. Ransome. I don't know whether there was any additional salary paid to Mr. Schussler during that time in connection with the opera-
7824 tion of the company, or whether that was in the nature of a special salary for that special service in addition to his regular salary, but I think not. I think that was his total compensation for all that time, 35 months.

RE-DIRECT EXAMINATION BY MR. GREENE.

Mr. Metcalf: For preliminary expenses of all sorts I give 1%. I don't know that I can segregate that between preliminary engineering and preliminary expenses in the way of promotion, and formation, and organization, but I should suppose that the promotion work would be certainly less than one-half of that sum.

7825 Witness: Geo. L. Dillman for Defendants.

Dillman

CROSS EXAMINATION BY MR. MCCUTCHEN.

I have assumed that a company acquiring this property, and constructing the structural portion of it, would be able to obtain money for construction purposes at 5% per annum. I have never known of a company starting in business of this nature, and getting money at 5% per annum, because I have never known of the initiation of a large water company of this kind. I have assumed that the construction would be begun in 1907 and completed at the end of 1913. I am acquainted with the general value of the securities of the company, the bonds. They would take precedence and desirability over all other local securities in that time, and I therefore assumed that the money could be gotten at 5%. The value of the bonds show that money could be gotten cheaper than that; that they were paying less than that the bulk of the time, and I think that 5% money could have been gotten for this purpose during the period of

construction. The company, during construction, would have a franchise back of its bonds, while the personal notes of the stockholders might have to be put up for a little while, they would every year have an increasing security, and the investor could be protected in the investment by a representation on the board of directors. I think that a concern whose credit was no better than to induce the money lender to insist on a place on the board of directors could borrow money in the market at 5%. To get money with which to buy its lands, it would create a bonded indebtedness on the prospective prop- 7826
erty, and the money would go directly to the purchase of it. I don't know that I have considered the land proposition, and I don't know that it is perfectly reasonable to suppose that they had the land. I am not assuming that they had the land, or that the land had been paid for, but I mean that they could borrow money at 5%.

The Western Pacific started its construction with an initial expenditure of about $300,000; they borrowed $45,000,000 on $50,000,000 par value securities, and that was not as good security at that time as a similar debt would be on the Spring Valley possibilities. There was where money was borrowed in that way at a little over 5%. If the personnel of a company was such as I have known the personnel of the Spring Valley Water Co. to be, I believe it could 7827
borrow money at 5% in this community, even though it were just starting in business. The personnel of the company has a lot to do with borrowing money, and I am borrowing money on the credit of the people that I have known to be connected with the company. I am assuming that the company is made up of men of good business reputations, and whose word would be made good. I have been 7828
acquainted with the Spring Valley Co. to some extent since 1892, and since I have known the company it has included pretty nearly every financially strong man in San Francisco. That is a very important element as to whether the company could get money at 5%. I consider the Western Pacific case, which I have cited as an example, as a case indicating the rate at which money could have been borrowed at one time. There was a guarantee to secure payment of the Western Pacific bonds, and that guarantee obviated the necessity of representation on the board of directors representing the investor, and as a matter of fact, the investor did not have a representation on the board of directors.

In nearly all cases municipalities in California have borrowed money without going beyond 5%, except in a very few cases. Of course, I do not compare the credit of an institution like this, beginning to build up a business, to a municipality. The Western Pacific is one big case that is directly in point, but that is the only one 7829
that I know of just now in this vicinity. There have been times when the rates for money for construction purposes were nearly prohibitive, and that was just after the fire here in San Francisco.

I think that that stringency was released early in the period of 1907
to 1913. There was a short period in 1907, occasioned by the panic,
during which no money could be had for construction purposes, and
I think it lasted less than a year. I have never borrowed money for
purposes of this nature, but I have always been able to get what
little money I wanted at 6%. I don't know of any prospective con-
struction that would warrant as low a rate of interest as the Spring
7830 Valley work. I don't know of security that is as good, or as well
considered by the investing public, as the Spring Valley securities
today. Assuming that we have this property, and want to construct
these structures, I do not know what you would have to pay for the
money with which to do that work. I would expect to pay 6%, be-
ing unknown in the business world, and if I got it for 6%, I would
think I was in great luck. It would depend entirely upon what kind
of an organization I could effect as to my board of directors. If I
could pick my board of directors, I would get my money for 5%, or
better, right in this town, and it would need their personal endorse-
7831 ments; it would only have to be known that they were active in the
operation of the company, and were the directors of the operations;
the ability to get money at 5% would depend upon my ability to
induce men of fine credit to associate themselves with me. If I did
not do that, and was starting this enterprise and gathering this
property together, I would have to pay at least 6%, as I am not
known in the investing world. Unless I could present such a pros-
pectus to the financiers and bankers of San Francisco as would in-
duce them to invest, I would have to pay more money than I would
otherwise. I would tell them, in my prospectus, in order to induce
them to invest, that I proposed to build these works; that here are a
lot of consumers who need this water. I would put up the argument
that was put up on the original promotion. I would pay the inter-
est that was paid on the original promotion if it was done at that
time. If it was done from 1907 to 1913, I would not. The rate of
interest you would pay if it were done from 1907 to 1913 would be
7832 5%. I borrowed small amounts at 5% during that time. The fact
that these securities were being sold in the market at a lower rate than
5%, and are being transferred now at a lower rate than 5%, shows
that it was possible for men of guilt-edged credit to get money at
5% here between 1907 and 1913. These bonds of the company are
4% bonds, and are sold at about $95. That means that they are pay-
ing a little over 4%. I think at one time they went down, but for
the average of that period that I mentioned they were away above
$82 or $83.

I am assuming a personnel in the company which would warrant the rate of 5%, and I think I could get it. Here is a chance to develop a waterworks for a community that needs the water, and there is not any doubt about the outcome; if there is any doubt about anything,

it is the doubt about the physical construction, and that would be obviated by the employment of such engineering talent as would wipe that out in the minds of most of the investors, and largely eliminate it in the minds of the rest, and I see no reason to believe that you would have to pay over 5% for this money, if these people whose credit is good wanted to borrow it. The market price of these securities is evidence that the company is borrowing the money at 5%. I don't know exactly what proportion of the bonded debt of the company bears to the total of the company's property. That helps on determining the market value of the bonds. It is not probable that I would borrow 7833
all the money; if I were promoting this enterprise, it is highly probable that I would get up a stock subscription list, and have a lot of stock subscribed before I ever attempted to issue the bonds. That makes the security a little better, and the rate a little lower. That would help out the bond money; the returns from the stock money would come in later. The investor would get a higher rate for his investment after awhile, or he would think he would, to cover up this period of no dividends on the stock.

I do not believe that public service investments in this state are so desirable and sought after that men would be willing to go into them if they only expected to get 5% on their money. I consider investments in public utilities very poor investments in the State of California today, but I say that in starting an enterprise of this kind you could get people to go in whose credit would enable you to get money at 5%, because this state of affairs as to the poorness of public utilities as investments has not developed until lately, and it is stronger today than it ever was. It has developed in the matter of 7834
the last 3 or 4 years. I was connected, to a certain extent, with public service enterprises in California prior to 3 or 4 years ago, and they were more desirable as investments then than they are now.

I did not state that I would expect to pay 6% because these investments were not attractive, but I said I would have to pay 6% because I was not known in the financial world sufficiently to inspire confidence to the extent of that extra 1%. In other words, the property without a proper personnel in the company, would not enable you to borrow money at 5% on it, with the conditions such as they were from 1907 to 1913. 7835

I am not very well acquainted with large enterprises of this kind. My large enterprises that I know about are railroads. I had some little connection with the Contra Costa Water Co. a good many years ago, and their money was gotten on about a 5% basis. They were an established company long before I had anything to do with them, and their 5% was secured by first mortgage bonds. I don't consider that comparable to this case that we are dealing with here, but I cite it simply as a reason why I cannot point to construction money in large enterprises similar to this in the State of California. The money

that went into the San Lorenzo Water Co.'s plant at Haywards went
in at a great deal less than 5%, and it staid there about 20 years with
absolutely no returns on the investment. I was not connected with
the company when the money went into it, but I know that from the
books of the company, and that they had no returns on that invest-
7836 ment for a good many years. In that case the corporation didn't
borrow money. The stockholders put up that money; it was their own
money that went in. I think I can take Walker's Manual of Securi-
ties, and point out several enterprises that were able to obtain money
at 5%, but when the money has been gotten at 5%, it has been with
a personal responsibility, and sometimes a stock bonus.

The preliminary expenses on the construction of this plant would
not be more than .2 of 1%, or $32,000. The preliminary expenses that
I have indicated there are simply such investigations as would be
made until you opened your stock subscription books, and the en-
terprise was a go.

Referring to the first page of my memorandum, under the heading
7837 of "Preliminary Expenses", where I have stated:

"1. Preliminary expenses, including preliminary engineering,
"legal expenses and franchise, these can properly be considered in
"toto; taking the estimate on structural properties, without overhead,
"at $16,000,000, .2 of 1% will amount to $32,000, and this figure is
"probably all that will be expended in preliminary work for these
"waterworks." That is my estimate of an outside amount that would
be spent in preliminary investigation prior to the time when the
decision would be reached to go ahead and construct these properties.
You would not, necessarily, have determined by that time all the
properties that were necessary to be acquired in detail in order that
the enterprise might go, but you would have acquired enough informa-
tion to know that the project was feasible physically, and that it
would probably pay financially, and you would go into it in earnest,
and start to spend money then. By that time you would have deter-
mined, approximately, how much water could be derived from the
property; you would have made measurements or gagings. I would
expect to gage the streams for 2 or 3 years, possibly, and I also would
7838 get a lot of hearsay evidence from residents who knew what those
streams would do. I would buy the property on the combination of
hearsay and direct evidence. I would not advise capitalists to buy
property of this description upon 2 or 3 years gagings alone; I would
also want hearsay evidence as far back as I could go. That would
consist simply of interviewing old residents as to the dry years; I
would have to discount their talk a little bit, some of it from acquaint-
ance, and some of it on general hearsay. If at the end of 3 years in-
vestigations I had not developed anything adverse, and had developed
everything in favor of the proposition, I would consider it favorable,
and go to it. For this 3 years preliminary work I would expend

$32,000. My force would consist during that 3 years of some honest men who could gage streams and interview those people; that would 7839
be $10,000 a year.

I would pay attention to dam-sites during that time. I would not locate my works entirely before that; I would run some preliminary levels to understand the feasibility of the physical construction. I know that you could take out any number of 3-year periods during the history of this company, the gagings during which would not give you anything like an accurate notion of what you could rely on, but I would take a 3-year period, and in addition, the general reputation of the country as to rainfall, and the history of dry years, etc. I would take Government Reports that were pertinent, but not rely upon them absolutely. I don't know whether San Francisco came to rely on them when it came to determine whether it would construct the Hetch-Hetchy project.

I do not know what the preliminary expenses of the Hetch-Hetchy project have been compared with the cost of it, as the City Engineer of San Francisco has reported it will cost. The preliminary engi- 7840
neering on Hetch-Hetchy should stop when they determine to construct Hetch-Hetchy. I don't know whether it would be .2 of 1% or what it would be.

I know something about the original Hetch-Hetchy proposition, and the determination by the Board of Public Works that that was the best supply for San Francisco, was made, I think, before there had been spent .2 of 1% of $45,000,000. I remember that Mr. John R. Freeman, after that, advised the City that it did not have sufficient information to warrant it in going ahead with that project. The pre- 7841
liminary expenses that I am speaking of in connection with Hetch-Hetchy was the expense of investigation of the Sierra Nevada water supplies for San Francisco. I include the investigation up to the point where the Board of Public Works of San Francisco decided that the Hetch-Hetchy was the best and most desirable supply for San Francisco as the preliminary work. I state, without knowing what the figures, are, my belief that the preliminary expense was less than .1 of 1% of the cost of the proposed works. The City of San Francisco has not changed their recommendation on all the moneys they have spent since. Not being entirely acquainted with all the expense, but being more acquainted with the expense prior to that time than subsequently to that time, I would say that that is the point at which to cut off preliminary expense. If, at that time, I had ascertained enough of the facts, physically and financially, to warrant me in the belief that the project should proceed, I should recommend it to my board of directors, and if they have enough confidence in me, they would adopt that recommendation, and they would go to it, and thereafter the expenses would not be preliminary, but they would be construction. If I did not get a sufficiently approximate knowledge at 7842

that time as to the final results, then they would have employed the wrong man.

Questioned by Master.

I mean, when I speak of reaching a period when I would stop with my classification of preliminary expense, that I might make further preparations, but carry it into my 5% engineering. There is lots of investigation to be made all during this construction. You could not make all the preliminary investigations, or sound all the possible dam-sites, nor you could not determine on their exact location at that time. The office expenses of reconnaissance comes in direct engineering.

CROSS EXAMINATION BY MR. McCUTCHEN.

By reconnaissance I mean reconnaissance in location of dams, conduits, city distribution reservoirs; they precede and give information of how to direct location in detail, and with sufficient exactness to proceed with the work. I would not have located my dams exactly
7843 in my preliminary work, but I would have located them approximately. The soundings or borings for dams is investigation, not reconnaissance. I would not, in my preliminary work, attempt to ascertain whether I had a dam-site, and you would not be very sure that you did have a dam-site; you would not be sure as to the definite cost of it until you had made an investigation. You would not know that you had a dam-site at all until you had made the investigation, unless you had experience in that part of the country. You get that experience as you make your preliminary investigation, but you would not expend that enormous amount of money before you determine to proceed with construction.

During these three years that you are carrying on investigations,
7844 some one man would be employed constantly on this business. I would have about 2 office men, and a draughtsman and a bookkeeper would constitute my office force. In the property where I was determining what the runoff was and the stream flow, I would have two or three men. I might have one or two more men connected with the engineering department other than those I have mentioned. They could be looking up other supplies, and doing useful work in the way of reconnaissance. If I spent my whole time at it, I suppose my salary during these three years would be $4,000 or $5,000 a year. I would not put a very high priced man there; you would want honesty and energy more than you would want special competence. It is perfectly
7845 possible that I would not spend more than three or four days a month on the job myself. A man would spend his entire time on that job to advantage for three years, but it would not necessarily take all of the time to investigate it. He would have subordinates capable of measuring water, and constructing some inexpensive weirs and gaging stations. The exact location of tunnels and conduits would not be done

with this preliminary money at all; the preliminary investigation would be possibly some leveling work and mapping, but would not include any extensive field costs. I would have somebody determine whether there were adverse streams from which I proposed to take water. I would have that done by an attorney, and his services would 7846
also be covered by this $32,000 item. I would employ him to look into water rights on certain streams, and I would furnish him field data, diversions, and other information that he could not get from the records.

I have not said that the only thing I would do would be to spend 4 or 5 days a month on the job for 3 years, with possibly one or two men making reconnaissances. I have said that about all I would expect to spend in preliminary investigation was in the neighborhood of 7847
$30,000, and I do not know in great detail just how I would spend that $30,000, but I do know that I would have considerable information about the capacity of streams, the water supply, and some information regarding the elevations, and therefore the possibility of gravity flow. I would have some idea about the necessary location of the pumps where there was not a gravity flow, and I would get this information, not only by the investigations that I would make with my own men, but I would ask questions of a great many people, or have my subordinates do so, and I would know these subordinates, and would know whether to give them 100% credibility or less. In that way I would expect to get a great deal of information, not sufficiently exact to an absolute certainty, but approximate truth, and I would not recommend it to my board of directors without telling them exactly what I had done, and I would probably be working for these very men, as I am not a promoter. There would be somebody else promoting this thing, and I see no reason to believe that $30,000 is not sufficient for preliminary expenses, or for expenses which are preliminary to the determination to go ahead and build these works.

As a rule, I would not carry on my investigation in an open manner, but my secrecy of movement would not be hampered by having a small force, and it would not be expensive either; it would not add to the expense any.

I think I have had no experience in doing preliminary work for a 7848
large supply such as this; on small supplies I have not had to do anything in secret. I thing that $32,000 is all that I would spend before a determination to go ahead in a more expensive way. I think that would be enough to provide me with the information that would warrant me in advising them to go ahead with an investment which would ultimately amount to $30,000,000.

The .8% in my estimate which was not accounted for in any specific item I would put in one place under one condition, and in another place under others, depending entirely on who I was doing the work for. 7849

On page 3 of my memorandum, where I state "The above is my "analysis of overhead. It amounts to 9.2%. If this is increased to "an even 10%, it will accord with my practice in such matters for "many years", I refer to the practice of estimates on proposed constructions in that statement. I have no record of any construction of my own. I have knowledge of completed construction within my estimates, small construction to be sure, but 10% added to a carefully computed estimate in which the quantities were not in doubt, for this overhead including the interest, is enough. If the quantities were not computed, and I were going to do this work, I would scan them very carefully, and possibly allow a percentage on the actual quantities as computed, particularly from profiles and other methods. I would not allow a greater overhead in that case, but I would increase the quantities in case they were doubtful. In this case they are not doubtful, they are agreed, so that that element of doubt is eliminated by this method of appraisal. My overhead on any estimate that is carefully
7850 itemized and computed as this is would be 10% as being safe overhead. If the quantities were not carefully computed, that does not increase the overhead. That makes your estimate shy that much. If these quantities were not carefully computed, I would compute them, and if I had some doubt about them, I would add to the quantities. My overhead in that case would be the same as it is here, but the agreement upon the inventory eliminates all doubt; that takes away one element. It is perfectly proper in some cases to add 25% overhead, and let it include these other things. Overhead in that case does not mean what it means in this case; overhead can include a good many things. If the quantities were in doubt, I could cover that doubt by an increase in overhead, but it would not be as good a way to do it as to increase the quantities. I have frequently taken an engineer's estimate of quantities, computed it, and added 3% to his quantities in my estimate, to which was afterwards added 10% overhead.

7851 I do not think that I would make very much of an estimate at the end of my preliminary investigation. I don't know how much I could tell the capitalists they might be called upon to invest at the end of that $32,000 investigation. I might not be able to tell them at that time within 50% of what they might be called upon to invest, but if the investigation was satisfactory, I would tell them to go ahead. I would give them the facts. I would not deceive them at all. At that
7852 stage of the game they would put up money for stock. I am just presuming that the promotion goes ahead as a good many of these do; then the investigations would continue, and they would come under the expenses of direct engineering.

Questioned by Master.

Mr. Metcalf: The percentage of Mr. Dillman's total interest-during-construction is 5.82 which is applied on 110%, and which makes

the total overhead and interest-during-construction allowance 16.3%. I got that by going through his appraisal.

Mr. Dillman: I think that is correct. Some units are small, and I have not computed any interest on them; the maximum interest that I have computed is 7½% on the city pipes, but generally I have added only 5% for interest.

RE-DIRECT EXAMINATION BY MR. SEARLS. 7853

I have spoken of two pieces of construction which have come within my estimate; one is an irrigation plant for the Oakdale Irrigation District, in which the intention was first to get the main work completed and a few laterals, but the money held out so that we could build a great many laterals in addition to what we expected to build at the start. Another was the waterworks and sewer system in a little town, which was a side issue during this irrigation work, in which we had a little money left over at the end of the construction, I think about 5%, and with that we constructed a municipal swimming pool. I think there was about $1,600,000 involved in the irrigation plant, and $80,000 or $90,000 in the city works. I used 10% overhead for a great many years where an estimate was carefully computed; where there was a doubt about it, I have sometimes used a higher additional percentage, which was to cover other items than are covered by this 10%.

RE-CROSS EXAMINATION BY MR. MCCUTCHEN.

I have used 15%, and once in awhile 25%. The case in which I used 25% was a proposed power plant on Kern River. It was for a man named Barker, and I think was for a 3,000 horse power plant. 7854
That was not built. There was a diverting dam, some ditches, some pipe lines, flumes and tunnel involved in the construction of that power plant. I did not go over all the work and tell Mr. Barker how much would be the cost of each of those elements. I made him a written report, I think, several years ago. He is the John Barker who lives up on Kern River, near the Rio Bravo Ranch. The 10% that I speak of in the case of Oakdale was found to be a proper estimate in that case. It covered the law department, but they did not get very much; in proportion to his services, he got the smallest fee of any lawyer that I have ever been connected with. I don't think that that 10% was liberal. The trustees were compensated, but they were not putting their whole time in on this work. They were putting in on this work 7855
all the time they were putting on the enterprise, and they got compensation. The 10% is in addition to a preliminary estimate. Now, those items are wiped out and put into direct charges during construction, there is administration, engineering, and so on in a properly conducted set of books. I don't know what the overhead was, in fact. I just say that estimate panned out very well, and I added 10% to the estimate, and it was a carefully made estimate. I don't think it was

as carefully made as this. That 10% covered all the overhead in that case. The overhead that I could compute there, including the engineering, administration and legal expenses, was less than 10% of the amount that was expended.

7856 I made a written estimate of what that work could be done for. The estimate that I have made in dollars and cents is based on my idea of what the work should cost for cash. That work was actually done for a bond issue, and therefore the bond discount comes in there, and the estimates that I speak of as having panned out there, was an estimate made for the board, and after consultation with them as to what they could stand in the way of cuts and so forth, that the money was enough to build the main works, but very few of the laterals; that is an estimate that came out very nicely, because they had a good many miles of lateral in addition to anything that they, or that I expected.

I think very likely that on this Oakdale work there were some of my estimates that did not come out so nicely, but they were parts of this original estimate, and the general estimate came out all right. I think probably there is on file with that irrigation district, a report from me, in writing, as to what that work would cost, and in which there is a statement or item of overhead. My recollection is that that statement as to overhead in that report is 10%. I am not positive
7857 about that. It is a matter of memory. I did not allow anything for interest during construction in that case at all. That is, I made no estimate on it, nor did I make any estimate on bond discount.

I have some records of overhead which are not mine. I have no records of my own construction showing overhead, because I have no records of my own construction anywhere. My sole efforts in connection with construction has been either to better the construction, or to hasten or cheapen the construction, and except for the preliminary estimate and the final estimate, and by final estimate, I mean after the work was completed, I have no records of my own construction.

Dockweiler Witness: J. H. Dockweiler for Defendants.

CROSS EXAMINATION BY MR. MCCUTCHEN.

In determining overhead and interest during construction, I have assumed that all of the elements of the plant will be completed at 12 o'clock, midnight, on the 31st of December, 1913, and the taps will all be turned on and water will begin to be supplied to every consumer in the municipality. I have not allowed for the possibility of some element of my plant not being completed at that time. I have assumed they were all ready to perform their functions. It is within possibili-
7858 ties that some vital element of the plant would not be ready at that time. I have not made any specific or special allowance for that; I

have laid out a tentative program, and have assumed that the structures will be ready at that time.

There is a point as you get along where you can note your progress, and you might find that you have to begin something earlier, but it is the best arrangement that I could make. If it happened that some vital element of the plant was not ready at midnight on the 31st of December, 1913, you would be compelled to carry all of your plant until that vital part could be brought into service. I am satisfied that my figures, taken as a whole, will bring about that result. That is, an allowance for that possibility. I have got the advantage in the history; I know what has been done, and I cannot disassociate that history with the presence of the town; I have assumed the records of the company are available. I am in the same position as a man who 7859
would be called upon to say, well, what am I going to do with a plant of this size. I would say it supposes a town of this size which is being furnished with water; otherwise I am putting back on to the historical system of building it. I cannot escape that. I am either reproducing it as it stands for every use, or else I have got to go back and reproduce it in the manner in which it was built, and at the times.

ONE HUNDRED AND EIGHTH HEARING. MARCH 2, 1916.

Witnesses: C. E. Grunsky for Plaintiff.
Allen Hazen for Plaintiff.

Witness: C. E. Grunsky for Plaintiff. Grunsky

DIRECT EXAMINATION BY MR. GREENE.

I think I am in a position to clarify what I said in my first examination in the matter of the procedure that I followed in a certain portion of my valuation. 7860

The inquiry related to the use of a ratio of 10 to 1 in the matter of approximating what had actually been paid for lands in the reservoir sites at the three tracts, Pilarcitos, San Andres and Crystal Springs. That 10 to 1 ratio was used in apportioning total costs of the various tracts when taken in the aggregate of the cost of the land 7861
within the reservoir and the land in the watershed, in order to get some idea of what the price was that had actually been paid for the lands. As stated in my testimony, if that cost is some indication of the value of the lands at the time they were bought, that would, in some measure, help to determine what the value might be at a later date on some assumption of increase in value between dates.

The 10 to 1 ratio was used merely for the purpose of approximating probable costs of lands at the time of the purchase. In order to make that plain, I have written a statement which explains the use of that ratio more in detail. This is headed "Peninsula Reservoirs".

The adoption of the 10 to 1 ratio in distributing cost to reservoir and watershed lands''. It is as follows:

Preliminary to the adoption of 10 to 1 as a general ratio between the cost of the reservoir and the cost of the watershed lands at the Crystal Springs, San Andres and Pilarcitos Reservoirs, other ratios were tried and costs were studied and the conclusion was reached that, when taken in their entirety as though the three reservoirs were a single unit, this adopted ratio would enable a sufficiently close approximation of the average price paid for the reservoir land. My studies show that taken in the aggregate the per acre cost of the reservoir land was at least ten times greater than the average cost per acre of the watershed land.

The essential facts which bear out this conclusion will appear from what follows:

In Table 18 is presented a summary of the results of the apportionment of cost to reservoir and watershed lands at Crystal Springs, San Andres and Pilarcitos.

Table 18 is attached, and is entitled ''Peninsula Reservoirs; Study for apportionment of cost to reservoir and watershed lands at
7862 various ratios of cost per acre''.

In this table for each of the three reservoirs, Crystal Springs, San Andres and Pilarcitos, in columns, is given the information relating to the total area of the selected tracts, the area in the reservoir, the area in the watershed, the total cost, the apportionment of the cost on the basis of a 10 to 1 ratio, for the reservoir the estimated cost per acre and for the watershed the estimated cost per acre. And the same information for the 5 to 1 ratio, for a 3 to 1 ratio and for a 2 to 1 ratio. The table gives then the figures which appear in the original tables that were submitted by me for the 10 to 1 ratio, and additional information that was before me at the time that that was introduced.

In Table 19 the result of the apportionment of cost at various ratios to reservoir and watershed, for the selected tracts of Table 1, at Crystal Springs, is shown.

That table is also attached to this statement, and it speaks for itself. The amounts and figures noted at the bottom of the table are the same figures which appear in the summary, in the column headed ''Crystal Springs'' in Table 18.

In Table 20 the result of the apportionment of cost at various ratios to reservoir and watershed, for the selected tracts enumerated in Table 2, at San Andres, is shown.

In Table 21 the result of the apportionment of cost at various ratios to reservoir and watershed, for the selected tracts enumerated in Table 3, at Pilarcitos, is shown.

It has been found:

a. That a 10 to 1 ratio indicates average costs of watershed lands at the several reservoir sites, combined and treated as a unit,

which if used in lieu of value have to appreciate at the rate of 4.5 per cent per annum to reach an average value at the cost of 1913 at 7863
the three sites in substantial accord with the appraisals (at an average of $166.50) by Messrs. Baldwin & Hoag. The interest is compounded.

b. That the purchases in which watershed lands predominated at the Crystal Springs Reservoir site indicate a probable average cost of $27.00 per acre of watershed, while the 10 to 1 ratio indicates a cost of $42.10 per acre, for the selected tracts enumerated in Table 1.

c. That the purchase of lands at the San Andres Reservoir site indicates a probable average cost of $29.00 per acre of watershed, while the 10 to 1 ratio applied to the tracts enumerated in Table 2 indicates a cost of $15.60.

d. That the purchase of lands at the Pilarcitos Reservoir site indicates a probable average cost of about $5.00 per acre of watershed and the 10 to 1 ratio indicates a cost of $4.85.

e. That the total cost of the selected tracts of land at the three reservoir sites was $985,980 and at San Andres and Pilarcitos together $104,973, the purchase price at these two sites being only 11% of the total cost of the tracts under consideration at all three sites.

f. That in the approximation of a ratio of cost between reservoir and watershed land when all reservoirs are considered as a unit, the ratio of the cost of the reservoir land as compared with the cost of the watershed land at Crystal Springs greatly outweighs any ratio that may be found at the other two reservoirs.

g. That the apportionment of cost on a ratio of 10 to 1 throughout—that is for all of the selected tracts at the three reservoir sites— 7864
indicates an average per acre cost of watershed land of about $32.30.

A first approximation of the cost of the watershed lands at Crystal Springs Reservoir, may be made as follows:

The tracts which have large amounts of watershed land and a relatively small amount of reservoir land as enumerated in Table 1.

Will state at this point that a diagram has been prepared on which these various tracts are shown, with the date of purchase and the per acre cost of each tract of land that is referred to in this statement.

"C. E. Grunsky, map of reservoir and watershed lands" introduced and marked 'Plaintiff's Exhibit 158' ".

No. 39, this refers to the Crystal Springs Reservoir, on the west side, near the north end of the reservoir, purchased in 1874, 2162.25
acres of which 2094.05 are in watershed; average cost per acre, $17.86. 7865

No. 90, on east side, Howard Tract, purchased in 1886, 981.50 acres of which 856.10 are in watershed; average cost per acre, $124.45.

No. 48, on east side near south end of reservoir, purchased in 1875, 1161.78 acres of which 925.88 are in the watershed; average cost per acre, $60.25.

No. 49, on west side at south end of reservoir, purchased in 1875

659.80 acres of which 643.90 are in the watershed; average cost per acre, $23.49.

The total cost of these four tracts was $246,274, and their combined area is 4965.33 acres. Consequently the average cost thereof is about $50.00 per acre. This cost includes the reservoir land of these tracts. The cost of the watershed if considered apart from the reservoir land would be less than this average cost.

With these purchases there are to be compared the following which give some indication of the price paid in 1874 to 1886 for tracts containing a fair proportion of Crystal Springs Reservoir land.

Tract 41, average cost per acre..............	$133.48
Tract 94, average cost per acre..............	709.24
Tract 92, average cost per acre..............	406.19
Tract 96, average cost per acre..............	274.84
Tract 47, average cost per acre..............	212.01
Tract 68, average cost per acre..............	404.72

These tracts together have an area of 1213.85 acres and were acquired at a cost of $466,894, or at an average cost of about $380.00 per acre.

Tract No. 38 which is not enumerated in Table 1, contains 95.14 acres of which 71.32 acres are in the reservoir and 23.82 acres are watershed land. This tract was acquired for $37,500 or at an average
7866 cost per acre of $394.00.

These figures show that much land at Crystal Springs was acquired at a per acre cost of about $400; and a comparison with the first approximation of the price paid for watershed lands indicates that a ratio of at least 400 to 500 or 8 to 1 may be expected as the main ratio between reservoir lands and the watershed of the selected tracts. It is probable that this ratio is too low because the first approximation of the cost of the watershed land was made by the aid of purchases which include reservoir land and is therefore high and the first approximation of the cost of the reservoir lands was made from purchases of various tracts, each of which contained some watershed and is therefore low.

Accepting, however, for the purpose of closer approximation of the cost of the reservoir lands a ratio of 8 to 1 then in the case of the four tracts Nos. 39, 90, 48 and 49 the probable cost of the watershed would be as follows:

Tract 39 watershed area ...	2094.05 ac. at	$14.60..	$ 30,573
Tract 90 watershed area ...	856.10 ac. at	65.70..	56,245
Tract 48 watershed area ...	925.88 ac. at	24.90..	23,054
Tract 49 watershed area ...	643.93 ac. at	20.00..	12,878
Combined area	4519.93 ac.		$122,750

Average per acre of the four tracts.......... $\frac{122,750}{4519.93} = \$27$

The two tracts 39 and 49 are on the west side of the reservoir valley. The apportioned cost in the case of these two tracts indicates as the average cost of watershed lands on the west side:

$$\frac{30573 + 12878}{2737.95} = \ldots\ldots\ldots\ldots\ldots\ldots\ldots \$16 \text{ per acre.}$$

The two tracts 90 and 48 are on the east side of the reservoir valley. The apportioned cost in the case of these two tracts indicates as the average cost of watershed lands on the east side: 7867

$$\frac{56245 + 23045}{1781.98} = \ldots\ldots\ldots\ldots\ldots\ldots\ldots \$45 \text{ per acre.}$$

If these figures be accepted as sufficiently approximate to watershed cost upon the two sides of the reservoir the following calculation can now be made to approximate what would have been the average per acre cost of the watershed lands at the Crystal Springs Reservoir as enumerated in Table 1 if these had been acquired apart from the reservoir lands.

Tract No.	Area.		
72 and 73	285.25		
90	856.10		
36	103.14		
54	64.32		
37	350.43		
48	925.88		
East side	2585.12	at $45	$116,330
41	42.45		
40	9.33		
94	4.95		
97	68.09		
92	31.31		
68	829.77		
39	2094.05		
96	12.20		
47	49.25		
46 and 45	297.90		
50	310.90		
59 and 89	53.24		
55	24.70		
49	643.90		
West side	4472.04	at $16	71,552
Both sides	7057.16		$187,882

This indicates the average cost per acre (about 1882) of all the watershed lands included in the tracts enumerated in Table 1, upon both sides of the Crystal Springs Reservoir to have been about

$$\frac{187882}{7057.16} = \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ \$27 \text{ per acre.}$$

7868 At the San Andres Reservoir, Tract No. 130 containing 390.04 acres was purchased in 1896 at $15.38 per acre. This tract lies west of the central portions of the reservoir with one corner at the flow line of the reservoir. It is all watershed land. If it had been purchased in 1868 it would probably have cost something less.

Tract No. 13 which has an area of 531.95 acres of which 375.30 acres are watershed and 156.55 acres are reservoir land, was acquired at a cost of $13,000 or $24.44 per acre.

If the cost of this land is apportioned to the reservoir and to the watershed, the watershed will fall well below this average cost.

Tract No. 43, which has an area of 392.69 acres has only one acre in the reservoir. It was purchased in 1874 for $11,487.50 or at an average cost per acre of $29.25.

Tract No. 14 which includes a portion of the dam site as well as reservoir land, lies on the west side and has an area of 234.56 acres. It was bought in 1868 and cost $6350 or an average of $27.07 per acre. If the cost of this land is apportioned to the reservoir lands and to the watershed on any reasonable basis the acreage cost of the watershed will undoubtedly fall well below $20.

The only tract of land on the east side of the reservoir which has a large excess of watershed over reservoir area in Tract No. 15. This was acquired in 1868. It has an area of 153.75 acres, of which 10.40 acres are reservoir land. The average cost of this land was $70 per acre. If apportioned to watershed and reservoir areas the average cost of the watershed would be below this amount per acre.

None of these facts establish with any definiteness the probable
7869 average cost of the watershed lands near San Andres Reservoir. Neither are there any purchases of purely reservoir land that would establish conclusively the average per acre cost of such lands in 1868.

Taking the cost of the east side watershed to have been about $60 (or somewhat less than the average per acre cost of Tract 15) then under combination of Tracts 16 to 21 which are in a general way similar to each other as to location, it will be found that these tracts have a combined area of 385.09 acres of which 135.80 acres are in the reservoir and 249.29 acres are in the watershed, closely adjoining the reservoir and upon the east side thereof.

These tracts together cost................	$ 42,864
Tracts 16 to 21, total cost.................	42,864
Watershed 249.29 ac. at $60..............	14,957
Probable cost of the reservoir lands........	$ 27,907

Per acre cost of the reservoir lands........ $\dfrac{27{,}907}{\$135.80} = \$200$

This analysis indicates that the watershed on the east side of the reservoir may have cost about one-third as much and on the west side one-tenth to possibly one-twentieth as much as the lands in the lower end of the reservoir.

If for purposes of approximation $60 per acre be introduced into the calculation as the probable per acre cost of the east side watershed lands and $15 as the cost of the west side watershed lands, then the average cost of the watershed lands as enumerated in Table 2 can be approximated as follows:

(No. 18 is omitted because it is in two widely separated parts upon opposite sides of the reservoir).

7870

Tract No.	Watershed Area.		
15	143.35		
17	17.39		
20	16.90		
19	43.12		
21	20.72		
16	67.61		
East side	309.09	at $60 =	$18,545
13	375.30		
12	102.79		
14	175.26		
West side	653.35	at $15 =	9,800
Total	962.44		$28,345

Average per acre watershed cost.............. $\dfrac{28{,}345}{962.44} = \$29$

If this approximation average cost of the watershed lands be applied to the aggregate area of watershed enumerated in Table 3 or to 1045.99 acres, the amount will be $30,334.

Total cost of the selected tracts...............	$84,977
Estimated cost of watershed	30,334
Computed cost of reservoir lands	$54,643

There are 440.45 acres of reservoir land in the selected tracts at the San Andres Reservoir, therefore, this analysis indicates an average cost of these reservoir lands at

$$\frac{54{,}643}{440.45} = \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \$124 \text{ per acre.}$$

At San Andres if considered apart from the other reservoirs of the Peninsula system the ratio of the cost of reservoir lands to the cost of watershed land, as indicated by this cost analysis, is about 5 to 1.

At the Pilarcitos site there are no data available for a conclusive determination of the relative cost of watershed lands as compared with the cost of reservoir land.

The purchase of Tract No. 52, containing 2989.82 acres of which
7871 68.50 acres are in the reservoir site, in 1866 at an average cost per acre of $5.48 indicates a probable per acre cost of the watershed lands of about $5 per acre.

The purchase of Tract No. 16 containing 320 acres, of which 24.10 acres are in the watershed, in 1889, at an average cost of $10, indicates a cost at that later date of watershed lands considerable below $10.

At an assumed cost below $10 per acre for the watershed of Tract 51 the cost of the reservoir lands in this tract which is located near the upper end of the east arm of the reservoir and was acquired in 1866, would appear to have been more than 10 times greater than that of the reservoir lands.

It seems reasonable from these facts to assume that a ratio of 10 to 1 which indicates an average cost of watershed of $4.85 per acre is as likely to be the correct ratio at the Pilarcitos Reservoir when all three tracts are considered collectively, as any other.

Some idea of the value of the watershed lands at Crystal Springs, at San Andres and at Pilarcitos at the times at which the bulk of the lands at each reservoir site were acquired 1882, 1868, 1865 can be obtained from their value as determined for the year 1913.

The selected tracts at Crystal Springs enumerated in Table 1, were appraised:

For 1913 by A. S. Baldwin at an average of.......	$200.00	per acre
For 1913 by W. R. Hoag at an average of........	211.00	per acre
Mean of the two...........................	$205.50	

At an annual appreciation of 5 per cent the values of these lands in 1882 have been $45.30 per acre compound interest.

7872 The selected tracts at San Andres, enumerated in Table 2, were appraised:

For 1913 by A. S. Baldwin at an average of......	$108.00	per acre
For 1913 by W. R. Hoag at an average of........	150.00	per acre
Mean of the two	$165.50	

At an annual appreciation of 5 per cent the value of these lands in 1868 should have been $18.40 per acre.

The selected tracts at Pilarcitos, enumerated in Table 3, were appraised:

For 1913 by A. S. Baldwin at an average of......	$100.00 per acre
For 1913 by W. R. Hoag at an average of........	60.00 per acre
Mean of the two...........................	$ 80.00

At an annual appreciation of 5 per cent the value of these lands in 1865 should have been $7.70 per acre.

When these possible values are compared with the cost of the watershed lands at each of the three reservoirs, which a 10 to 1 ratio would indicate, it is found that at the Crystal Springs Reservoir the value deducted from the recent appraisal is lower than the approximated cost and that in the case of each of the other two they are somewhat higher, but not sufficiently at variance to discredit the assumed 10 to 1 ratio as applicable to the combined reservoir and watershed areas of the reservoirs.

If the three reservoirs be treated as a unit the time at which the lands may be assumed to have been purchased is about the year 1876 or 37 years before the year to which the appraisals of Messrs. Baldwin and Hoag apply.

The appraisal of all the watershed enumerated in Tables 1, 2 and 3 was as follows:

For 1913 by A. S. Baldwin at an average of......	$170.00 per acre	7873
For 1913 by W. R. Hoag at an average of........	163.00 per acre	
Mean of the two	$166.50	

The apportionment of the total cost $985,980 of the 13204 acres covered by the three Tables Nos. 1, 2 and 3, to the 1924 acres of reservoir land and 11280 acres of watershed land on the basis of a ten times greater cost of the reservoir than the watershed land, indicates an average per acre cost of the watershed of $32.30 per acre.

If this cost approximately represents value at the time of purchase or about the year 1876 the appreciation in the value of the watershed lands would have been at an average annual rate of about 4½ per cent.

It has been shown from an analysis of certain individual purchases of land at the three reservoir sites that the probable average price paid for watershed was about $27 per acre at Crystal Springs, about $29 at San Andres and about $5 at Pilarcitos.

In the case of the Crystal Springs Reservoir this price is materially below the $42.10 per acre indicated by the 10 to 1 ratio as the per acre cost of the watershed. It seems probable that in the case of

this reservoir the average price paid for reservoir lands was considerably more than 10 times as great as that paid for watershed.

In the case of the San Andres Reservoir the price paid per acre for the watershed is greater than that indicated by the 10 to 1 ratio and it is probable that 5 to 1 would more nearly represent the fact.

7874 In the case of the Pilarcitos Reservoir the ratio 10 to 1 is as likely to be the proper one to use as any other that could be suggested as an aid in apportioning cost to reservoir and watershed areas.

Taken collectively the ratio between the average cost of reservoir land and that of watershed lands was probably in excess of 10 to 1, consequently the reservoir land costs, as determined for the three reservoirs on the basis of this ratio are more likely to be below the real costs than above the same when considered in the aggregate.

In the case of the individual reservoirs a closer approximation could have been made by using a smaller ratio at San Andres and a larger ratio at Crystal Springs. But for the purpose for which the ratio was adopted a uniform assumption of 10 to 1 was a sufficiently close approximation. The 5 to 1 ratio at San Andres would have indicated an average cost there of about $131 per acre of reservoir land instead of $156 as indicated by the 10 to 1 ratio. An 18 to 1 ratio at Crystal Springs which would have made the indicated cost of watershed about $28 per acre or in substantial accord with the cost otherwise approximated, would have indicated an average cost of the reservoir lands of $490 per acre.

If these ratios had been used instead of 10 to 1, the approximate cost of the reservoir lands at San Andres would have been found about 16% less and the probable cost of the reservoir lands at Crystal Springs would have been found about 16% greater than shown in Tables 1 and 2.

Alameda Creek Reservoirs. Some examination of the cost of the reservoir lands of the Alameda Creek system has also been made but without any conclusion having been reached relating to the distribution of cost at the reservoir sites to reservoir and watershed lands.

7875 The result of this examination of cost has been tabulated and is submitted in the following tables:

Table 22. Alameda Creek Reservoirs. Summary of study for the apportionment of cost to reservoir and watershed lands.

This Table 22 gives the same information for the three reservoirs, the Calveras, the San Antonio and the Arroyo Valle, that is given in Table 28 for the Peninsula system.

Table 23. Calaveras Reservoir site. Study for apportionment of cost to reservoir and watershed lands.

Table 24. San Antonio Reservoir site. Study for apportionment of cost to reservoir and watershed lands.

Table 25. Arroyo Valle Reservoir site. Study for apportionment of cost to reservoir and watershed lands.

In the case of the San Antonio Reservoir site, the apportionment of cost was only made on the basis of 3 to 1 and 2 to 1. I should have said that in connection with Table 24. And as to Table 25, the Arroyo Valle Reservoir site, that is simply made for the possible ratios of 3 to 1 and 2 to 1.

These tables were all prepared before I gave testimony in this case in last August, with the change, however, that I made a correction that was necessary by reason of having had erroneous information as to the area of reservoir and watershed in Tract 55. That necessitated corrections which have recently been made in these tables.

The 10 to 1 ratio is simply an approximation made as the one that would fairly represent the distribution of cost in this particular case. 7876

(The tabulation attached to Mr. Grunsky's statement here follow):

Table 18. 7877

PENINSULA RESERVOIRS.

Study for apportionment of cost to Reservoir and Watershed Lands at various ratios of cost per acre.

Summary.

	Crystal Springs	San Andres	Pilarcitos
Total Area of Selected Tracts	8,444.62	1,486.44	3,272.95
Area in reservoir	1,387.46	440.45	95.90
Area in watershed	7,057.16	1,045.99	3,177.05
Total cost	$881,007.30	$84,977.00	$19,996.50
10 to 1 Ratio:—			
Res. Est. Cost per acre	421.00	156.00	48.50
Watersh. Est. Cost per acre	42.10	15.60	4.85
5 to 1 Ratio:—			
Res. Est. Cost per acre	315.00	131.00	27.40
Watersh. Est. Cost per acre	63.00	26.20	5.48
3 to 1 Ratio:—			
Res. Est. Cost per acre	235.00	108.00	17.30
Watersh. Est. Cost per acre	78.30	36.00	5.77
2 to 1 Ratio:—			
Res. Est. Cost per acre	179.00	88.00	11.90
Watersh. Est. Cost per acre	89.50	44.00	5.95

7878

Table 19.

CRYSTAL SPRINGS RESERVOIR.

Study for Apportionment of Cost to Reservoir and Watershed Lands at various ratios of the cost per acre.

No. Tract	Reservoir Acres	Watershed Acres	Total Cost	Apportioned Cost per acre: 10 to 1 Res.	10 to 1 Watershed	5 to 1 Res.	5 to 1 Watershed	3 to 1 Res.	3 to 1 Watershed	2 to 1 Res.	2 to 1 Watershed
72	24.00	8.80									
73	8.10	276.45	$ 26,974.75	$ 445.00	$ 44.50	$ 302.00	$ 60.40	$212.00	$ 70.67	$154.00	$ 77.00
41	2.50	42.45	6,000.00	890.00	89.00	547.00	109.40	360.00	120.00	253.00	126.50
40	3.90	9.33	5,500.00	1,140.00	114.00	954.00	190.80	785.00	261.67	642.00	321.00
94	9.50	4.95	10,248.55	1,025.00	102.50	978.00	195.60	920.00	306.67	858.00	429.00
97	18.70	68.09	7,500.00	294.00	29.40	232.00	46.40	181.00	60.33	142.00	71.00
92	48.70	31.31	32,500.00	628.00	62.80	591.00	118.20	540.00	180.00	506.00	253.00
90	125.40	856.10	122,150.00	579.00	57.90	411.00	82.20	297.00	99.00	221.00	110.50
68	150.27	829.77	396,645.83	1,700.00	170.00	1,252.00	250.40	930.00	310.00	700.00	350.00
36	32.10	103.14	8,150.00	192.00	19.20	154.00	30.80	123.00	41.00	97.00	48.50
39	68.20	2,094.05	38,624.35	139.00	13.90	79.00	15.80	50.00	16.67	35.00	17.50
96	11.45	12.20	6,500.00	513.00	51.30	468.00	93.60	418.00	139.33	370.00	185.00
54	39.90	64.32	5,000.00	108.00	10.80	95.00	19.00	82.00	27.33	69.00	34.50
37	166.00	350.43	15,492.90	77.00	7.70	65.00	13.00	55.00	18.33	45.00	22.50
47	21.50	49.25	15,000.00	567.00	56.70	478.00	95.60	396.00	132.00	325.00	162.50
46	144.10	150.43	40,250.00	223.00	22.30	191.00	38.20	161.00	53.67	134.00	67.00
45	6.70	147.47									
50	170.90	310.90	42,000.00	208.00	20.80	180.00	36.00	153.00	51.00	129.00	64.50
59	9.50	6.18	392.12								
89	0.00	47.06	4,706.00	343.00	34.30	253.00	50.60	187.00	62.33	141.00	70.50
55	74.24	24.70	11,872.80	155.00	15.50	150.00	30.00	144.00	48.00	137.00	68.50
49	15.90	643.90	15,500.00	193.00	19.30	107.00	21.40	67.00	22.33	46.00	23.00
48	235.90	925.88	70,000.00	213.00	21.30	167.00	33.40	129.00	43.00	100.00	50.00
	1,387.46	7,057.16	$881,007.30	$ 421.00	$ 42.10	$ 315.00	$ 63.00	$235.00	$ 78.30	$179.00	$ 89.50

Table 20.

SAN ANDRES RESERVOIR.

Study for Apportionment of Cost of Reservoir and Watershed Lands at various ratios of the cost per acre.

No. of Tract	Reservoir Acres	Watershed Acres	Total Cost	Apportioned Cost per acre. 10 to 1 Res.	10 to 1 Watershed	5 to 1 Res.	5 to 1 Watershed	3 to 1 Res.	3 to 1 Watershed	2 to 1 Res.	2 to 1 Watershed
18	35.70	83.55	$10,965.00	$249.00	$24.90	$209.00	$41.80	$173.00	$57.67	$142.00	$71.00
15	10.40	143.35	10,762.00	438.00	43.80	275.00	55.00	185.00	61.67	131.00	65.50
13	156.65	375.30	13,000.00	67.00	6.70	56.00	11.20	46.00	15.33	38.00	19.00
12	78.30	102.79	12,000.00	135.00	13.50	122.00	24.40	107.00	35.67	93.00	46.50
17	14.30	17.39	3,802.00	237.00	23.70	224.00	44.80	189.00	63.00	165.00	82.50
20	19.70	16.90	4,392.00	205.00	20.50	190.00	38.00	173.00	57.67	156.00	78.00
19	23.80	43.12	8,030.40	286.00	28.60	247.00	49.40	220.00	73.33	181.00	90.50
21	13.80	20.72	4,142.40	261.00	26.10	230.00	46.00	200.00	66.67	171.00	85.50
16	28.50	67.61	11,533.20	328.00	32.80	274.00	54.80	226.00	75.33	185.00	92.50
14	59.30	175.26	6,350.00	83.00	8.30	67.00	13.40	54.00	18.00	43.00	21.50
	440.45	1,045.99	$84,977.00	$156.00	$15.60	$131.00	$26.20	$108.00	$36.00	$ 88.00	$44.00

TABLE 21.

PILARCITOS RESERVOIR.

Study for the Apportionment of Cost to Reservoir and Watershed Lands at various ratios of cost per acre.

				Apportioned Cost per acre.							
				10 to 1		5 to 1		3 to 1		2 to 1	
No. of Tract	Reservoir Acres	Watershed Acres	Total Cost	Res.	Watershed	Res.	Watershed	Res.	Watershed	Res.	Watershed
106	24.10	295.90	$ 3,200.00	59.60	$ 5.96	$38.40	$ 7.68	$26.10	$ 8.70	$18.60	$ 9.30
5–1	3.30	28.33	785.50	128.00	12.80	87.80	17.56	61.70	20.57	45.00	22.50
5–2	68.50	2,852.82	16,008.00	45.30	4.53	25.00	5.00	15.70	5.23	10.70	5.35
	95.90	3,177.05	$19,996.50	48.50	$ 4.85	$27.40	$5.48	$$ 17.30	$ 5.77	$ 11.90	$ 5.95

Table 22. 7881

ALAMEDA CREEK RESERVOIRS.

Study for Apportionment of Cost to Reservoir and Watershed Lands.

Summary.

	Calaveras	San Antonio	Arroyo Valle
Total area of selected tracts	5,087.83	5,358.06	3,094.50
Area in reservoir	1,573.80	656.00	630.00
Area in watershed	3,514.03	4,702.06	2,464.50
Total Cost	$232,466.00	$246,222.45	$49,407.50
10 to 1 Ratio.—			
Res. Est. Cost per acre	126.00		
Watersh. Est. Cost. per acre	12.60		
5 to 1 Ratio:—			
Res. Est. Cost per acre	102.10		
Watersh. Est. Cost per acre	20.42		
3 to 1 Ratio:—			
Res. Est. Cost per acre	84.70	110.80	34.00
Watersh. Est. Cost per acre	28.23	36.93	11.33
2 to 1 Ratio:—			
Res. Est. Cost per acre	69.80	82.00	26.50
Watersh. Est. Cost per acre	34.90	41.00	13.25

Table 23.

CALAVERAS RESERVOIR SITE.

Study for Apportionment of Cost to Reservoir and Watershed Lands at various ratios of the cost per acre.

No. of Tract	Reservoir Acres	Watershed Acres	Total Cost	Apportioned Cost per acre. 10 to 1 Res.	10 to 1 Watershed	5 to 1 Res.	5 to 1 Watershed	3 to 1 Res.	3 to 1 Watershed	2 to 1 Res.	2 to 1 Watershed
E. 241	8.40	231.60	$ 9,450.00	$300.00	$30.00	$173.00	$34.60	$110.00	$36.70	$76.00	$38.00
223	4.30	435.70	5,000.00	104.50	10.45	54.80	10.96	33.40	11.13	22.50	11.25
325	407.20	392.80	30,000.00	67.20	6.72	61.70	12.34	55.80	18.60	49.70	24.80
327	14.10	65.90	1,900.00	91.80	9.18	69.70	13.94	52.60	17.53	40.40	20.20
322	66.40	93.60	11,250.00	148.50	14.85	132.20	26.44	115.20	38.40	99.30	49.65
A 241	35.90	598.18	24,964.00	261.00	26.10	160.50	32.10	106.00	35.33	74.50	37.25
329	16.70	23.30	250.00	131.50	13.15	117.00	23.40	102.00	34.00	88.20	44.10
328	43.20	156.80	1,250.00	22.25	2.25	16.80	3.36	13.10	4.37	10.30	5.15
323	167.90	32.10	13,500.00	79.30	7.93	77.40	15.48	75.60	25.20	73.40	36.70
324	146.70	53.30	20,000.00	130.00	13.00	127.00	25.40	121.50	40.50	115.20	57.60
B 241	61.80	578.20	25,197.00	220.50	22.05	141.50	28.30	98.80	32.93	71.90	35.95
321	193.00	299.90	29,000.00	136.00	13.60	114.50	22.90	99.00	33.00	84.50	42.25
D. 241	3.00	241.22	9,615.00	355.00	35.50	187.50	37.50	115.50	38.50	78.00	39.00
330	230.90	80.10	23,000.00	96.30	9.63	93.00	18.60	89.50	29.83	85.00	42.50
f 268	3.50	82.13	5,290.00	450.00	45.00	265.00	53.00	171.00	57.00	118.50	59.25
331	106.00	54.00	10,800.00	96.90	9.69	92.50	18.50	87.00	29.00	81.20	40.60
j 268	36.80	43.20	6,000.00	146.00	14.60	132.20	26.40	117.10	29.03	102.80	51.40
k 268	28.00	52.00	6,000.00	181.00	18.10	156.00	31.20	132.50	44.17	111.00	55.50
	1,573.80	3,514.03	$232,466.00	$126.00	$12.60	$102.10	$20.42	$84.70	$28.23	$69.80	$34.90

Table 24.

SAN ANTONIO RESERVOIR SITE.

Study for the Apportionment of Cost to Reservoir and Watershed Lands at various ratios of cost per acre.

No. of Tract	Reservoir Acres	Watershed Acres	Total Cost	Apportioned cost per acre			
				3 to 1		2 to 1	
				Res.	Watershed	Res.	Watershed
N. 239	33.80	731.06	$ 24,480.00	$ 88.20	$29.40	$61.30	$30.65
O. 239	181.70	239.30	16,719.00	64.00	21.30	55.60	27.80
M. 239	286.50	3,027.54	175,000.00	135.00	45.00	97.20	48.60
P. 239	3.00	457.63	16,115.55	103.70	34.60	69.60	34.80
R. 239	151.00	246.53	13,907.90	59.70	19.90	50.80	25.40
Totals and Means..	656.00	4,702.06	$246,222.45	$110.80	$36.93	$82.00	$41.00

Table 25.

ARROYO VALLE RESERVOIR SITE.

Study for Apportionment of Cost to Reservoir and Watershed Lands at various rates of cost per acre.

No. of Tract	Reservoir Acres	Watershed Acres	Total Cost	Apportioned Cost per acre — 3 to 1 — Res.	3 to 1 — Watershed	2 to 1 — Res.	2 to 1 — Watershed
B. 243	195.00	445.00	$ 8,000.00	$23.30	$ 7.79	$19.20	$ 9.60
M. 243	3.40	84.39	2,050.00	65.00	21.67	45.00	22.50
N. 243	124.50	113.31	5,983.45	36.80	12.27	33.00	16.50
P. 243	11.40	148.60	4,100.00	67.40	22.47	47.90	23.95
O. 243	23.00	....	2,050.00	89.10		89.10	
J. 243	.50	159.50	2,562.50	47.90	15.97	32.00	16.00
Q. 243	179.00	482.80	8,272.50	24.30	8.10	19.65	9.83
S. 243	42.10	282.00	6,644.05	48.80	16.27	36.20	18.10
R. 243	48.80	591.20	5,440.00	22.20	7.40	15.80	7.90
T. 243	2.30	157.70	4,305.00	78.50	26.17	53.00	26.50
Totals and Means..	630.00	2,464.50	$49,407.50	$34.00	$11.33	$26.50	$13.25

Mr. Metcalf: The accrued depreciation allowance by Mr. Hazen, as appears in "Exhibit 97", is $3,192,445. My accrued depreciation allowance is $3,496,136, or approximately $3,500,000. Mr. Dillman's was $5,129,176. Mr. Dockweiler's was $5,027,624. 7885

The annual depreciation allowance by Mr. Hazen was $219,333, or 1% of the depreciated structural values. That is the approximate figure, and may vary, as Mr. Hazen states.

My allowance was $260,000, covering physical and functional depreciation, with a further suggestion that a contingent allowance of $60,000 would be desirable. Mr. Dillman's allowance was $251,979. Mr. Dockweiler's was $268,737. In other words, Mr. Dillman's was slightly below and Mr. Dockweiler's slightly above mine, if you exclude the contingent reserve as applied to the annual depreciation allowance.

Witness: ALLEN HAZEN for Plaintiff. Hazen

DIRECT EXAMINATION BY MR. GREENE.

I prefer to discuss the matter of depreciation in connection with a whole review of the subject which I am making now, which includes some corrections for the agreed values as compared with the values which I estimated on a number of other things. That is an approximate figure. I do not want to be understood as going back on that in any way, it was a good, careful estimate at the time, but I may use a figure which differs from that. 7886

My allowances for depreciation are shown in Exhibit 97, which shows the estimated cost to reproduce, including overhead and present depreciation allowed on each of the structures, and the total accrued depreciation, and the estimated cost to reproduce less depreciation. These tables were made a year and a half ago, and represented the study which I had made up to that time. I have subsequently reviewed the whole subject, and described the methods I have used in reaching the depreciation on the different items. This is summed up in a statement which I now present.

In reviewing the figures first made, I criticise them as if they were made by someone else, and have suggested changes in them occasionally which I would make on further consideration; those changes are approximately the same up and down, and the original tables have not been corrected in any case.

Statement entitled "Methods of estimating depreciation, Allen Hazen" marked "Plaintiff's Exhibit 159".

I consider the question of depreciation along with the valuation, and as I inspected the various structures in the system, I tried to find out what I could by inspection or otherwise as to their 7887

condition and usefulness; so I accumulated the data for depreciation along with that for estimating the cost of reproduction.

In the case of the flumes, and woodwork, I frequently examined it to see if it was sound or rotten, and I looked at the places where my experience led me to expect where rotting would start first.

In the case of the pumping stations, I inquired as to the reliability and the efficiency of the works, and made studies of the operating costs, which reflect the condition of the machinery.

In the case of the pipes of the system, certain tests were carried out showing the frictional resistance of the pipes, and the amount that the carrying capacities was impaired. The carrying capacity of pipes is almost always impaired by age, but the rate at which the falling-off occurs varies greatly in different systems, depending both upon the character of the pipes and the character of the water.

I also made physical inspection of the pipes, both cast iron and riveted, where opportunity presented, and have especially looked over the yards of the company at Millbrae and at Bryant street, because I have found that the yards are the best places to get information as to the weaknesses of the system; when pieces are defective and are replaced, the defective pieces are pretty sure to be brought to the yard. By looking over all the stock that has accumulated of material of that kind, one gets quite an idea as to the condition of the system, and what is going on. I took all those things into account in making my estimate.

7888 Depreciation, as applied to existing structures, means the difference in worth of the structures, as they are and as they would be if they were new and free from deterioration, wear and corrosion.

Annual depreciation refers to the amount of money that must be set aside each year to cover the estimated loss by wear, tear and corrosion of structures, in order that the investment may be maintained.

I will include functional depreciation, but there are some parts of this system that I think require special treatment in that respect, particularly the Merced structures, and perhaps some other parts where there is a great deal of what is sometimes called functional depreciation. I have an idea of how that ought to be handled, and I will come to that later. I do intend to include every depreciation that ought to be estimated under this classification.

There are no fixed rules for estimating depreciation; different kinds of structures require different treatments. This will be illustrated by taking up some typical kinds of property in the Spring Valley system.

Flumes: Flumes are largely used to carry water. They take the place of pipes or aqueducts. They are built of wood and, in the past at least, have been much cheaper than iron pipes or masonry aqueducts. All of the oldest flumes in this system have been replaced; that is to say, the wood has rotted in places and ceased to be serviceable, and has been replaced with new. The whole of the structure was not replaced because the grading and excavation necessary for it and forming part of it remained
and formed part of the new structure as well as it had on the 7889
old one.

The records of the old flumes and of the time when they were replaced have not been investigated in detail, but from inquiry and the best information available, it is understood and assumed that they were usually replaced when from 30 to 35 years old.

The flumes first built sometimes had mud sills; that is to say, the frames rested directly upon the ground; in other cases the blocking under them was inadequate, so that when the earth moved by sliding, especially on steep hillsides, the earth and wood were in direct contact, or so near together that the wood was kept moist by the earth. Whenever this happened the wood rotted. When there were a few rotten planks in a flume they could be replaced with new planks without disturbing the others, but when the rotting became general it no longer paid to do this and it was better to rebuild the entire woodwork of the flume.

Mr. Lawrence and Mr. Sharon were the principal sources of my information on all historical matters. I also used to ask Mr. Schussler about things, sometimes, but not so commonly, because we did not like to trouble him about secondary matters. I did go to him, though, when I really wanted to get at anything I could not get elsewhere.

In all the flumes that have been rebuilt, and in all the more recently constructed ones, ample blocking has been used underneath and extra excavation done if necessary, to afford free ventilation between the earth and the bottom of the flume. All the flumes now in the system are protected in this way. That I
checked up by climbing down and getting under the flumes in a 7890
great many places. The effect of the difference in method, I may say, is something I know from personal experience. I did not take anyone's word for that, because I have had enough to do with wooden structures to know that if they are blocked up they are much more durable than if built directly on the ground.

The woodwork in these flumes may be reasonably expected to last considerably longer than in the earlier ones not so protected. How long they will actually last can only be told at some future time when they are gone. The oldest one now in

service is 25 years and the next oldest 16 to 18 years, and are apparently capable of indefinite extended service.

These figures refer to the first of January, 1914; they are two years older than that now.

A few remaining pieces of flume 40 to 50 years old, not now in service, throw some light on the durability of the wood under the climatic conditions to which they have been exposed.

In the East, wooden structures of this type would have a much shorter life· The greater durability of the flumes in California, is to be attributed first to the excellent character of the wood of which they are built, and second to the climate. The California summer is free from rains which in the East would result in the alternate drying and wetting of the wood, which at summer heat would rapidly cause its decay.

The flumes themselves are built of redwood of the best quality. The trestles and auxiliary structures are commonly built of Douglas fir, which is cheaper and suitable and which is listed in the inventory as Oregon Pine.

The life of the flumes, unlike that of other kinds of struc-
7891 tures, does not depend upon the amount of service that is obtained from them. If they are used constantly to the limit of their capacity, they will last just as long as if they are not used at all. It is necessary, however, that they should always be kept full of water, even when no water is flowing through them, and this is ordinarily practiced.

That is, the wooden bulkheads or dams are built at intervals so that when no water or but little water is flowing, the flume is still full or more than half full of water at all points.

Unlike pipes, there is no decrease in carrying capacity, with age. An old flume will carry as much water as a new one.

In estimating the depreciation upon flumes, the Sinking Fund method is used. That is to say, for a new flume an amount is allowed for depreciation each year, which if placed in a fund invested at 5 per cent would amount to the cost of the flume in the 40-year period taken as its life. Strictly this should be applied to the wood only, but as there may be doubt as to whether any particular flume will be rebuilt upon its exact site, this separation has not been made in my estimates.

In other words, I have depreciated the earthwork at the same rate as the wood.

By this method the sum of the interest on the investment and the annual allowance for depreciation will be equal for each of the 40 years of the assumed life. The total amount of accrued depreciation at any time will be measured by the computed amount of the sinking fund that would have resulted from carrying out this procedure.

This method is sometimes spoken of as the equal annual payment method· There are several ways of making the computations, but if properly done they all lead to the same results. In other words, the sinking fund method is the equal annual payment method.

I have assumed this method only when the rate of interest 7892
is the same as the rate in the sinking fund.

This method of estimating depreciation is more suitable for flumes than the straight line method. By the straight line method, one-fortieth of the cost would be marked off each year. This payment would remain constant, but as the capital represented by the remainder became less the interest charges would become less. By this method the payments during the earlier years of life would be much greater than the average and during the last years would be less than the average.

In comparison with this and as a matter of practical experience, the load factor of such a structure as a flume ordinarily
increases as the years go by. The amount of service obtained from 7893
it normally is greater toward the end of its period of usefulness than at the beginning. If any deviation from the sinking fund method is to be made, it would be more nearly in accordance with the facts to make it in the other direction, so that the annual payments would be somewhat less in the earlier years of relatively smaller service and somewhat greater as the use of the structure became greater.

The 5% sinking fund table is used in the calculation. In general, it may be assumed that any funds resulting from consideration of depreciation will be invested in the plant and will earn as high a rate of return as the going rate on the money invested in the plant. With this in mind, a higher rate might properly be considered, but 5% is used as being a sufficiently close approximation for this purpose.

You see, as we get into this, that I have made only a relatively small use of the sinking fund method, and I did not consider any refinement as between interest rates as being necessary in using it for these parts. I mean to say by that I don't want to be bound to a 5% rate with reference to anything else. I have not used it in that way to make this a precedent for any other computation that may be needed later on.

Pumps, Boilers and Equipment. Pumps and boilers are taken as representing another class of structures for which depreciation may ordinarily be estimated by the same general method that is used for flumes, that is to say, by the sinking fund method, but in connection therewith some important exceptions are found.

The condition of the equipment at the date of examination may have a determining influence upon the depreciation that is allowed.

This condition depends upon the service that has been rendered by the equipment and upon the care which has been
7894 taken to keep it in order. Severe service or inferior design and workmanship, or lack of care in maintenance, may lead to a structure's being worn out before the expiration of the period which would ordinarily be considered to be its normal life. On the other hand, with usually good care, and with service that is not too hard, the equipment may be in better order than would normally be expected at its age, and the depreciation may therefore be less.

It is very common to find an old pump that has been taken good care of still doing efficient service, and being a valuable part of a system, a pump that is older than the age that would normally be assigned to a pump. Of course, we cannot go to the theoretical consideration of giving it a negative value, because it has gone beyond the period that would be assumed for its life; it has to be valued for what it is, and what it is capable of doing, and what it is fairly worth, regardless of any theories on depreciation.

Questioned by Master.

For that particular item my estimate of life was wrong, but not necessarily wrong for other items or that the average was wrong.

DIRECT EXAMINATION BY MR. GREENE.

The wear and tear on a boiler or pump worked slightly beyond its normal capacity will ordinarily be much greater in proportion than it will be with like equipment worked at a little less than its normal capacity. A pump run at 40 turns per minute may give efficient service for many years, but speeded up to 50 turns, it may pound itself to pieces in a comparatively short period. The speed that a pump will stand depends upon a number of matters. Some pumps will go much faster without damage than others.

The Spring Valley pumps, with a few exceptions, are of the same type, namely, cross-compound horizontal fly-wheel pumps.
7895 This type of pump is one that would be used today for corresponding service. The pumps were well built and were in fact a little heavier in proportion to the work to be done than recent corresponding pumps which we have had to do.

I went over that rather carefully. My first impression was that the Spring Valley pumps were a good deal heavier than the pumps which had been put in the pumping service which I have

built, and also the pumps which I have purchased. I went through the weights and the horse-powers very carefully, and I found that the Spring Valley pumps were a little heavier, but only a small percentage heavier than those which I, myself, had bought and installed.

The design was good and pumps have been well taken care of and they are in good condition today.

There is more bronze used in their construction and in the wearing parts in place of iron than has been common in American practice. That has added somewhat to the cost of the pumps, and also to their durability.

Questioned by Mr. Dockweiler.

Mr. Hazen: It may be that in some cases the bronze liners have been taken out, and soft cast-iron substituted for them in the plungers. I think the bronze is more durable, but the cast-iron is much more common. My impression is that you get less wear where you have two metals, one considerably harder than the other, than where the two are of the same hardness; in other words, a bronze on one side, and iron on the other, will give you less wear than if it is iron on both sides.

The oldest of these pumps—26 years old in 1913—is still 7896
giving efficient service, with indications of many years remaining useful life. One of the Millbrae pumps, 15 years old in 1913, moved to the Central Pumping Stations, set up, and put in service and tested, gave almost as high an efficiency as could be expected from a new pump of the best design and construction, under similar conditions.

That pump was tested by Professor Le Conte of the University and I went through his test and compared it with tests which I have made of new pumps of similar design.

Under these conditions the depreciation is unusually low and I have taken it as based upon an average useful life of 40 years, for all the cross compound fly-wheel pumps.

The pumps at Precita Valley and Ocean View are not of the same excellence, and the depreciation on them is heavier. It is estimated at from 30 to 60%, this being based upon their condition and probable use. These figures correspond to lives ranging from 20 to 27 years, most of which has already passed.

In other words, these pumps are simply rated by the way they seem to me; I have seen them running at Precita Valley; at Ocean View they were not running when I saw them. They have been running since, I understand.

The boilers in the Spring Valley system have usually been built for 40 pounds additional pressure above those ordinarily bought for the working conditions that are to be met; that is, they bought the 200 pounds instead of 160 pounds. This results

in giving them an increased margin and an increased life. The cost is about $2.00 to $2.50 per horse-power additional.

Boilers are now in service at Black Point that were 26 years old in 1913. The boilers have been well taken care of and are
7897 generally in good order. Depreciation has been based upon the sinking fund method, using ages of 30 to 35 years, according to present condition and the severity of the service which has been demanded from them.

All other pumping station equipment has been depreciated in about the same ratio as the main units which it serves.

Actually, the most expensive part of this equipment, namely, the masonry foundations, and the main gates and pipe connections, would have a much longer life than the pumps which they serve. New pumps are often installed replacing old ones and using in part the old foundation and connections. On the other hand, changes, with at least a partial rebuilding are commonly needed for new machinery. Some of the smaller auxiliaries have much shorter lives. Taking it all together there seems to be no reason for estimating the life of the equipment in excess of the life of the main structures.

Questioned by Mr. Searles:

I used the same method of depreciation on pumping stations that I did on flumes with the exception that instead of taking a uniform life I have varied it up or down according to the present condition of the units, so that if you tabulate my items they will not be quite uniform; they will show variations from it.

DIRECT EXAMINATION BY MR. GREENE.

Pipes: Cast-iron pipes ordinarily used in water works service are very durable structures. Experience does not extend long enough as yet to say what the average age of any of the more durable kinds of pipe will be. Very much the largest part of all the pipes that had ever been laid in the world in water works service is still in efficient daily use. The reasons for discarding a particular pipe line may be briefly noted: first, breakage; second,
7898 leaks; third, decreased carrying capacity.

Of these three ways in which a pipe may end its usefulness, that of breaking is much the less frequent. Breaks sometimes occur, but it is almost always possible to replace the broken part with a new length or otherwise effect a repair. The number of breaks in pipes in the Spring Valley system has been exceedingly small, and there is no reason to think that the limit of usefulness of any of the pipe will be reached in this way.

Leakage is a more important factor in reducing the usefulness of pipe lines. Leakage may take place around lead joints which

have moved in the course of years, or from holes resulting from pitting or corrosion of the metal. The larger leaks can usually be caulked or plugged or stopped. When there are many small leaks on an old line, the loss of water may be important, and to stop them all may be practically impossible, and this may be a determining factor. The pipes in the Spring Valley system are unusually tight and free from leakage.

That is indicated among other things, by the very small water consumption per capita, and I suppose it is to be attributed to the care with which the pipes have been laid and have been kept up. I understand—this is second hand—that after the fire the pipes of the system were gone over in great detail for leakage and tested out in sections, and that was followed up until they were practically made water tight in each section. This I got from Mr. Schussler.

The fact of tightness is a very important matter in considering the value of pipes. It is even more important here than it is in the East because the water is much more valuable.

The reduction in carrying capacity is very much more important in limiting the useful life of pipes than either leakage or breakage. 7899

Every pipe of cast-iron or of wrought-iron or of steel, will carry a certain amount of water under certain conditions of head when it is new. As time goes on, the interior surface of the metal begins to corrode, at some points at least. Protective coatings are used to guard against this, and they are efficient for the most part, but, notwithstanding corrosion gradually makes the interior of the pipe rough, and the quantity of water that can be carried by it under the same conditions is gradually reduced. This reduction in carrying capacity is progressive and more or less steady. On the other hand, there are wide differences in the rate of reduction of different pipes. Some waters corrode pipes more rapidly than others. For these reasons very great differences are observed in the rate of reduction in different pipes. It might be thought that experience would furnish a guide to the best kind of iron and coating to use, and it does to a certain extent, but the whole art is constantly advancing and changing. New materials are becoming available and old kinds cease to be made. One must select from those that are available at the time, and full knowledge of their durability becomes available if ever, only many years afterwards.

Exact data on reduction of carrying capacity of any particular pipe line are hard to get; nevertheless, there are occasional opportunities, and engineers who have studied the matter have co-efficients which they use to represent the rate of decrease that may be 7900
reasonably expected. Such co-efficient for cast-iron pipe and for

steel pipe, based on the best obtainable data, were published in a volume of hydraulic tables by Williams and Hazen, John Wiley & Sons, in 1905.

Much less information is available with respect to the decrease in carrying capacity of old wrought iron pipes.

In estimating the depreciation in pipe lines, the reduction in carrying capacity is one of the most important matters to be considered.

Depreciation is not in proportion to reduction in carrying capacity, because pipes are ordinarily laid anticipating a certain amount of such reduction in carrying capacity and because the cost of pipes is not in proportion to their carrying capacities. An assumption that may be made and that is helpful in considering the subject, is that a 12-inch pipe, when its carrying capacity has been reduced by corrosion to that of a 10-inch pipe, is reduced in worth to the cost of laying a 10-inch pipe, etc. This assumption does not represent the whole truth, but only one phase of it. It is an important phase, and one that merits careful consideration.

Then follows a table of depreciation on cast-iron pipe, based solely on reduction in carrying capacity; to explain this a little, the first line shows that a 30-inch pipe is estimated to cost $8.60 per foot; that is the figure which I used for District 3, easy digging. The next smallest size pipe in common use is 24-inch and that would cost $6.15 per foot, as shown on the following line. A 30-inch pipe must have its co-efficient, and by co-efficient I mean co-efficient in a certain formula for pipe flow which is described and used in the hydraulic tables of Williams and Hazen which I have referred to.

7901 This co-efficient which starts out about 130 for a new cast-iron pipe must be reduced to 72, before the carrying capacity of the 30-inch pipe is reduced to the carrying capacity of a new 24-inch pipe.

Now, the hydraulic tables show on the best data that the authors had at that time how fast these co-efficients reduced under American conditions, and these conditions I may say relate principally to Eastern waters that are rather soft and that were not filtered; they relate to those waters because the data that was available, which was meager, mostly came from systems in which waters of that class had been used, and the presumption that they applied to other waters and other pipes is not very strong. In other words, the presumption needs to be supported by local data before it can be taken as conclusive. But this is taken as an index, and in the absence of supporting data, it is the best general basis for estimating that I can suggest at this time.

On that basis a 30-inch pipe, 58 years old, will normally carry

as much water as a 24-inch pipe new. \$6.15, the estimated cost of building a 24-inch pipe is 28½% less than the cost of building the 30-inch pipe. So on this basis we have a depreciation of 28½% in 58 years for this particular case, and dividing 28½ by 58 gives a per cent annual depreciation on the straight line basis for that period of 0.49% per annum.

The table shows the corresponding calculations for the other sizes; and the rates of percent do not vary very much, averaging 48% for the whole range. The estimated costs used in this table were for laying pipe in the outlying districts without obstacles.

Questioned by Mr. Dillman.

Mr. Hazen: The formula for pipes for which this co-efficient was given in this table is V equals C into R raised to the 0.63 7902
power into S raised to the 0.54 power, into a constant factor, which is approximately 1.30. That might be included with C, but it was not. It represented an accumulation of considerations which squared the new formula with the Chesy Formula, which it replaced. The Chesy Formula was a French formula that had been widely used, and still is widely used, and certain co-efficients were used in it; there was a divergence between the Chesy Formula and the facts as developed by experiments on the flow of water. At the time this formula which I have just given was originated by Prof. Williams and myself, we went through the best available data on the flow of water in pipes and selected the exponents in this formula to agree as nearly as we could with the existing facts, not the facts in any particular case, but taking the whole range, the one that would come nearest to average water practice; we did that in a certain way, and when we came to adjust that to change from the Chesy data to this data, it was more convenient to let this constant 1.3 go in, and keep the co-efficient separately. That is all described in this volume which I speak of, which was published by Wiley & Sons.

Questioned by Mr. Searls.

V is the velocity of the water in the pipe in feet per second. C is the co-efficient, which is about 130 for new cast-iron pipe, and ordinarily falls to about 110 in 10 years, and 120 in 20 years, and so on, gradually decreasing. R is the hydraulic radius of the pipe, being the average depth of water in the pipe over the perimeter in feet, and S is the slope in feet per thousand of the pipe; that referring to the loss of head of water in the pipe, and not to the actual physical slope of the pipe. The average area by the 7903
wetted perimeter gives the average depth.

Questioned by Mr. Dillman.

The decreased carrying capacity is due to tuberculation, largely. I have been told that there was no tuberculation in

California. I have been told that with reference to a number of systems, but I looked in the scrap yards of the systems that I have visited on the Pacific Coast, and I have always found tuberculation in the old pipe from every system that I have seen. I have seen some pipes as well peppered with tubercles in California as I have seen almost anywhere.

Questioned by Mr. Searls.

That applies to cast-iron pipes, and the Spring Valley cast-iron pipes, ordinarily, were coated in Scotland in the old days, or in the East in recent days, and I do not think that the coating used on them differs in any radical way from the coating used in cast-iron pipe elsewhere in the world. The Spring Valley coating, as we have used the term, relates to the special coating made here, and made for dipping the riveted pipes. I do not think that was used on the cast-iron pipes.

At the ordinary rate of reduction in carrying capacity for
7904 the largest size of cast-iron pipes, this results in a rate of depreciation of about ½% per annum. This applies to pipe 6 inches in diameter and over. For 4-inch pipe, and smaller, other considerations often raised the rate so as to practically govern it.

This general conclusion, reached many years ago for Eastern conditions, has been tested out with the San Francisco estimates, and is found to be approximately correct. The rate at which these iron pipes decreased in carrying capacity has also been investigated experimentally by finding the frictional resistance of known quantities of water in passing through 8-inch pipes of various ages.

That was done by Mr. Saph before I came out here, and the petometer measurements of flow in 8-inch pipes were made, and differential gages were attached to the pipe some hundreds of feet apart, and the water was drawn from a hydrant to produce the flow, and the amount of friction in Spring Valley 8-inch pipes was actually determined in that way.

The study was carried out with 8-inch pipes with result that this seemed to be quite normal and it did not seem to be necessary to incur the very considerable expense of extending it to other sizes. The 8-inch pipe laid is the predominating size in the Spring Valley system. This result indicated that the friction was a little more in San Francisco than the figures that are
7905 ordinarily used for estimating. That is, the co-efficients were a little smaller here than were given in the Williams and Hazen hydraulic tables, but the rate of decrease with increasing age checks well with that obtained from Eastern information. In other words, they did not quite get the 130 with new pipe here, and the drop from the new pipe was just about normal; why they did not get 130 for new pipe I am unable to state, but it seemed

to me that they ought to have secured it, but Mr. Saph could not find it; the difference was not a very radical one and it did not seem necessary to carry the experimental investigation further for this purpose. But substantially the investigation showed that the results all the way through were in accordance with the Williams and Hazen hydraulic tables, based on Eastern experience; but there was a little difference; it was fairly constant.

If the calculation were repeated on the actual San Francisco results it would not make any appreciable difference in the conclusion that I draw.

In applying this reasoning to pipes it must be borne in mind that a certain reduction in carrying capacity is contemplated when a new pipe is proposed and it is seldom that estimates are based upon utilizing more than 80% of the full amount that a pipe will carry when new.

In our own office work we almost always figure for a coefficient of 100, when a new pipe carries 130, and under average conditions the 100 is reached in about 20 years; in other words, we take as the starting point for our calculation the capacity after 20 years deterioration has taken place; that is our ordinary office practice, of course modified if there are any special conditions that require modifying.

It is also to be noted that the carrying capacity of a new pipe 7906
ordinarily decreases rather rapidly for a few years, especially when carrying unfiltered surface water, and afterwards the decrease is slower.

That suggests an exception to the answer that I gave to Mr. Dillman. Most of the reduction in carrying capacity is due to the tuberculation, but there is an initial drop which is apparently due to the coating of the surface of the pipe with slime from the water; that is a matter of some importance, and probably that goes forward always; it is always there; its effect is covered up later on by the reduction due to tuberculation. So I would like to make that correction.

Questioned by Mr. Dillman.

This does not relate to mud; if there is mud in the pipe, that will reduce the carrying capacity, because it will reduce the area. This is not allowing for any filling of the pipes with mud.

DIRECT EXAMINATION BY MR. GREENE.

The rated carrying capacity commonly used in laying out work to be built is that found after the first rapid falling off in capacity has taken place. From this standpoint it may be questioned whether the rate of depreciation should be taken as great as indicated by the reduction in carrying capacity from new pipe to the condition of the pipe 20 or 30 or 40 years old.

If, on the other hand, the first rapid decrease be excluded and only the more gradual increase should be taken into account, a considerably lower figure would be reached. Nevertheless, the decrease in carrying capacity to be normally expected in large
7907 pipes is one of the most important factors to be practically considered in estimating depreciation.

The length of time that any pipe has been in service is important in estimating the depreciation, principally because in the absence of other measurements, it is the best and, in fact, only basis on which the probable carrying capacity can be estimated.

I say only; that of course excludes the making of experiments such as Mr. Saph made on other pieces of pipe. That would not be feasible.

When the carrying capacity of old pipes has been considerably reduced it is possible to restore it in large measure by the use of an appliance called "go-devil". The possibility of doing this has been frequently used as a reason for reducing the depreciation which might otherwise be based on the reduction in carrying capacity. The success of the "go-devil" in the last years and the improvements in the process that have been made have been such as to give considerable force to this contention.

On the other hand, the restoration in carrying capacity is not complete or permanent, and the treatment would have to be periodically repeated. The effect of this procedure tends to reduce the allowance but not to eliminate it.

The "go-devil" is a very old institution; it has been used in a limited number of places for a long time. It was taken up in the United States in a large way perhaps 10 or 15 years ago, and it has received a very large use. It is a very promising method of cleaning old pipes and restoring their capacity, and the work can be rather cheaply done, and when it is done and arrangements made for it, the successive treatments in following years can be done even at a good deal less than the first treatment. So I
7908 regard that as a very practical matter.

It is a scraper built in such a way as to take off the tubercles without scraping off the coating; it has a rough piston behind it so that it is driven through the pipe by water pressure; in other words they put a box, or two boxes, at the ends of the pipe and in one of these the "go-devil" is placed, and then the cover of the box is put on and the appropriate gates being opened the water flows through the pipe and forces the "go-devil" before it and it takes off the tubercles and pushes them ahead with the excess of water which gets by it and it comes out at the other end and the pipe afterwards is pretty smooth and restored in great measure to its original carrying capacity.

Questioned by Mr. Dockweiler.

Mr. Hazen: It would not go through the 12-inch gate. It is a practice that has been coming on in recent years to put in a gate a couple of inches smaller than the diameter of the pipe. You do not very often find it in old systems; it is the best practice at the present time, but wherever that happens, the box has to be placed on either side of the gate.

DIRECT EXAMINATION BY MR. GREENE.

The sinking fund method is often used in estimating depreciation in cast-iron pipe. The fundamental difficulty is to determine the life of pipe that is to be assigned. No records are long enough to show it. If a very long life is assumed, it results in an annual rate that is too low as measured in other ways. I think it may be well to insist that as far as I can find data, and I have studied this matter for a long time, there is no basis by which 7909
anyone can determine the life of cast-iron pipe. The lives that are assigned to it by even the most careful estimators are arrived at by indirect methods, which I think are not reliable, and it is my judgment that the lives that are assigned that have resulted from the discussions of this subject, really have been reached backwards; that is, the annual depreciation that resulted from those lives has been discussed, and the life has finally been selected to give a depreciation that was measured in other ways as reasonable. There is one error particularly that may grow out of this. If the life is built up to correspond with the reasonable rate of depreciation, using the sinking fund method, and some figure, say 80 years, is reached, which really rests on that and nothing else, and then it is decided to go from the sinking fund method to the straight line method, the depreciation that corresponds to the 80 years on the straight line method is entirely out of line with the data on which the procedure was based, and consequently is not reliable. Personally, I do not think that either the sinking fund method, or the straight line method is fairly applicable to cast-iron pipe.

For the present I will make a distinction there between cast-iron and riveted pipes for the purpose of this discussion. I will come to the riveted shortly. Even if the average life of cast-iron pipe could be ascertained, it is not clear that knowing it would serve as a proper basis for calculating depreciation by the sinking fund method. A better basis would be the average rate of sinking fund payment, corresponding to all the different parts of the pipe at their respective lives. This is a very different basis from that of the sinking fund 7910
payment, corresponding to the average life. One has to make this calculation on some assumptions to see what a tremendous difference it makes; it does make a very wide difference.

As a matter of fact, if 100 miles of pipe are laid at one time, some of it may be taken up or replaced by other pipes the same year that it is laid, and some of it will go out of service every year thereafter, but the amount remaining in useful service at the end of any interval, even a very long one, will ordinarily be large.

Pipe ordinarily goes out of service because with the increased use, and decreased carrying capacity it is no longer fit for the particular service demanded of it. It is very seldom discarded for other reasons. The growth of the community served by it is, on the whole, more apt to be the determining factor than the reduction in carrying capacity by corrosion, although both count.

If it could be ascertained that of 100 miles of pipe laid at one time, the average expectancy of life was 80 years, then 10 years afterwards, when perhaps 2% or 3% of it had been replaced, it would not follow that the expectancy of life of that remaining service was reduced by 10 years, or to 70 years. In other words, the pipe that has gone out of use in the 10 years interval was part of that on which the 80 years was based, and the expectancy of life of that which remains is only a little less than it was for all of the pipe at the beginning. This proposition is exactly similar to that in life insurance; as age advances, the expectancy of life in years decreases, but not directly, and the age that may be reasonably anticipated steadily becomes greater as a man becomes older.

7912 I will now take up several items in the pipe schedules, beginning with the screw pipe. The screw pipe is mostly 2-inch galvanized steel pipe, laid to serve customers where the business will not justify the expense of cast-iron pipes, or possibly in some cases where the company has not the money at the time to pay for the larger pipe that it might otherwise be glad to lay. If the district grows considerably, a 2-inch pipe will normally be replaced by 6-inch cast-iron pipe after a certain interval. The galvanized pipe is fairly durable, but does not have as long a life as cast-iron. The average age of this pipe in the system is ten years; 20% depreciation is used, corresponding to a useful life of 30 years; that is on the sinking fund curve. This is the 5% curve and 10 years old; a 30 year life corresponds to 19% depreciation; 20% corresponds to perhaps a 29 year life. I think such a charge will be found in almost any of the standard text books or works
7913 on the subject. That is the method that I ordinarily follow in using the sinking fund method. It is not precise, but it is close enough. It is quite as accurate as the data on which it rests.

Questioned by Mr. Searls.

With respect to screw pipe, 30 years; my estimate of 20% comes first. I estimate that I will take 20% off that screw pipe as estimating fairly its decrease in worth, because it is not new. For convenience of the people who prefer to figure on the sinking fund method, I give them the information that that corresponds to a 30 year life, of which

10 years have already elapsed. I did not take that as the primary point in the calculation, but I expressed it that way to facilitate comparison. If I figured it that way, I would have to make an estimated life to determine the annual contribution to a sinking fund, but I am not going to figure the annual contribution that way.

DIRECT EXAMINATION BY MR. GREENE.

The 3-inch cast-iron pipe was formerly used. There is a limited amount of it. It is no longer laid. It averages 29 years old. It is much more durable than the screw pipe; otherwise, it serves a similar purpose. It has greater carrying capacity. I estimated 50% depreciation on that.

The 4-inch cast-iron pipe is present in relatively small amounts, and forms a useful part of the system, especially in the outskirts, where business is light, and also where it furnishes cross-connections not longer than one or two blocks, between larger mains. That is, a 7914
fair fire protection can be obtained from a 4-inch pipe fed at both ends as long as the houses to be protected are not too large. 4-inch cast-iron pipe is not laid to a great extent at the present time. The average age of that now in the system is 28 years, and depreciation is estimated at 28%. That corresponds to a life of 50 years, of which 28 are elapsed; the expectancy of life corresponding is 22 years. That is on the sinking fund curve. Where I give the corresponding life and the expectancy, it is always on the sinking fund method.

The 6- and 8-inch cast-iron pipe constitute the bulk of the system. The estimated cost of reproduction of these items is \$2,815,000. The average age is 26 years; \$425,000 depreciation is assumed on these two sizes, equal to 13%. That is half a percent per annum. This corresponds to a useful life of 60 years. Expressed in another way, the allowance amounts to ½% per annum, and thus corresponds to the decrease in worth as measured by the decrease in carrying capacity, following the calculation outlined above, and with no allowance for go-devil, or any other considerations. The \$425,000 depreciation is 13% of \$2,815,000; that is ½% per year. The 13% is my judgment of a fair allowance to make on that pipe. I don't believe I could give any absolute reason why it might not be 12% or 14%. I think the 7915
depreciation corresponding to the decrease in carrying capacity is a large element in my judgment, and that is just what that comes to. There would be other things that would modify that, the use of the go-devil would tend to reduce it, while the possibility of leaks would tend to increase it. Those would be the most important things. That is just my judgment in view of those conditions. As far as the life of 60 years by itself is concerned, I don't pay any attention to that at all. I don't think that represents the life of the pipe. I have made these calculations to facilitate comparing with people who make their calculations that way. With the screw pipe the 30 year life more

nearly corresponds with the life of the pipe. I have had experience as to that, and that rests on a better basis.

The large cast-iron pipe, sizes ranging from 10 inches to 30 inches, of which 12-inch pipe predominates, has an average age of 19 years. I have written off on this table a depreciation of $94,200, which is equal to about 3%. That corresponds to a life of 80 years by the sinking fund method. From another standpoint, the depreciation amounts to 0.16% per annum, and is thus less than the amount which would be reached by consideration of the reduction in carrying capacity starting from new pipe. From the standpoint of useful life of pipe, 80 years is not an excessive estimate for those larger sizes; in fact, I think it is too low, looking at it from the standpoint of durability only. On the other hand, the undoubted decrease in carrying capacity must be considered, though it may be questioned if it should be controlling. The advantages of restoring the larger pipes to capacity are greater, I think, relatively, than with the smaller ones, and the total length of the
7916 pipe is much less. Then again, the slower decrease in capacity, after the original drop, might be taken instead of reckoning it from new pipe, and that also would make a difference. But taking it altogether, I am disposed to think that the depreciation allowed in the schedule for those items is somewhat too low, and in going over it again, I am disposed to add 50%, making it 4½%, adding $47,000 to the depreciation, and deducting this much from the depreciated worth of the structures. I have some other items the other way that approximately offset that. I did not revise these sheets, which were the first sheets I made, and which we used in a good many early discussions.

For riveted wrought-iron pipe in the distribution system I estimated for the 12-inch wrought-iron pipe, on the sinking fund basis, a life of 35 years. There is only a very little of that; 22-inch pipe, with a life of 45 years, of which 35 years have already elapsed, leaving only 10 years to go; and the larger sizes, from 30 to 44 inches, have been assumed to have a life of 55 years. In a general way, this results in a depreciation of a little less than 1% per annum, which is considerably more than could be accounted for by the reduction in carrying capacity. These riveted pipes in the city are probably less durable than cast-iron pipe, although what their life will be will only be determined by experience. There is not any experience at the present time that establishes it, but I think they are less durable than the cast-iron pipe, and that the depreciation should be estimated on a larger basis. The larger lines, the 30-inch and the 44-inch, are the important
7917 lines. The smaller pipe of this kind I regard as less desirable, and less valuable, and to have depreciated accordingly. On the outside pipe lines the sinking fund method also has been used, but the length of life has been usually assumed to be greater. This is because pipes are subject to less deterioration on the outside than in the city. The great age of some of the pipes now in the service must be taken into

account, together with the fact that while some sections of the oldest pipes under severe conditions have deteriorated, and have been replaced, there is still a great deal of the old pipe in serviceable condition, and most of the old pipe shows hardly any deterioration on inspection, and promises to have a very long future life; 60 or 65 years is commonly assumed.

Various lines of pipe are depreciated more than correspond to the ages usually assumed because of their condition or connection, and here is where we get the functional depreciation. For instance, some pipe lines to the Ocean View Pumping Station are depreciated because this service is regarded as temporary in character, and the pipes serving the pumping station will probably not be used after the pumps go out of service. Similar considerations lead to a higher, than the normal rate of depreciation, on some of the auxiliary structures at Millbrae. The 30 inch Pleasanton pipe was made of very thin sheets of "Allan Wood" iron. Depreciation was first reckoned on the idea that this material was in reality steel. Subsequent tests, and information from the manufacturers, shows that the metal used was puddled 7918
iron. On this information the allowance should be reduced from $8,500 to half this amount, a change of $4,250. I think I have made an addition to my annual depreciation allowance to cover functional depreciation, obsolescence, and inadequacy.

Questioned by Mr. Searls.

Those pipes which I stated were laid to the pumping station, and which would probably obsolesce in the near future, I think probably could be taken up and relaid, but I simply allowed considerable more depreciation on that than I would if they had been in a more permanent location. When they cease to be used where they are now, they will be taken up, and whatever salvage value they have would be charged to the new job, it would be credited to this line, and charged to the line where they go. The cost of laying in the new location would be made up of the salvage value from the old location, and the cost of putting them in the new location. The haul would have to be reasonable, as judged by the relation to the cost of laying new pipe.

As to whether I should consider such work as a replacement, or 7919
in whatever category it would go, is something for consideration as having an influence on my depreciation reserve, but the pipe, if it is in good order, and otherwise in good condition, has a pretty large salvage value, and that would be taken into account in fixing the depreciation; in other words, the depreciation would not go down to zero at the time it ceased to be useful where it is now, but would only go down to what it was worth in place, taking into consideration the fact that it would have to be taken up and cleaned and dipped before it could be relaid. One of my exhibits shows just how much of that experience they had with respect to the Pilarcitos line; it is a very

large percentage of it, as I remember it, that is now in service in different parts of the system.

I would not make any account, in figuring the depreciation, as to the cost of relaying it. I would leave that until the time arrived. I think I am doing all that can be done with depreciation in fixing the depreciation so that it will mark off all the costs down to the salvage
7920 value. The cost of relaying would enter into a consideration of what the salvage value would be.

DIRECT EXAMINATION BY MR. GREENE.

On the auxiliaries of pipe lines, referring to the gates and services in the city distributing system, in Table 22 of "Exhibit 97", I have estimated 13% depreciation, which corresponds approximately to the average depreciation on the cast-iron pipe; actually it is a little more than the average. The services do not relate to the service pipes, but only to the corporation costs.

For meters an allowance of 20% depreciation is made. The average age of meters in use January 1, 1913, is not known to me. It is assumed to have been eight years, and the depreciation allowed corresponds to a life of 25 years. Some parts of the meters wear out and have to be replaced. Keeping up the meter, and replacing these parts, is ordinarily included in maintenance. With this done, the meters are very durable structures, and probably last more than 25 years.

Questioned by Master.

I have in Table 22 estimated cost of reproduction, including overhead, \$495,000; percent of depreciation, 20; cost and overhead, less depreciation, \$395,000; I have taken that in rough figures, and it turns out that I have called it 1/5 of \$500,000. These were all made on the slide rule. I used a round percent practically always, and did it with the slide rule, and that is all the accuracy that is worth while. Oftentimes my figures have been checked by some of the assistants and carried out. Wherever that appears it is a pure indication that
7921 someone else did it.

Tunnels and Dams: With these an entirely different idea of depreciation enters. Tunnels and dams in waterworks service are never discarded because of age. Generally speaking, they suffer no depreciation with time. In fact, as structures, time often adds value. The dams of the Spring Valley system, tested by many years of successful use, and by having met earthquake shocks, and known to be and remain tight, are distinctly more valuable than new, and untried structures would be. A dam or a tunnel becomes less valuable, and suffers depreciation, when it is no longer suited to its service under changed conditions. When that happens, it depreciates in value, even though it has no physical defects. For instance, the Upper Crystal Springs Dam is a perfectly good dam, and to reproduce it would cost a certain sum of money; it has been deprived of its main usefulness by the con-

struction of the Lower Crystal Springs Dam. Its worth is now limited to the value of important secondary uses that it still serves.

Questioned by Mr. Searls.

I don't mean that I am now considering depreciation on the deteriorated structure. The procedure appears on page 5 of Exhibit 97, where the old dam, as it is called, the estimated cost of reproduc- 7922
tion, including overhead, is entered at \$336,000; 60% depreciation is marked off, leaving a net of \$135,000. The \$135,000 is what the estimate for a road amounted to, and the 60% is obtained by the difference. I do nothing further with that here; I don't apply the 60% twice.

Questioned by Master.

Dams sometimes depreciate by siltage. I don't know of any appreciable filling up of the reservoirs of this company. I have not investigated that particularly, but generally speaking it is clear water that comes to them, and reservoirs receiving that kind of water do not silt appreciably.

Questioned by Mr. Searls.

The Upper Crystal Springs Dam does serve the purpose of keeping the muddy water from going into the lower lake, but the greatest amount of sediment I have ever seen in that water would not make very many cubic yards of mud on the bottom.

Questioned by Mr. Greene.

That would not enter into the depreciation of the structure, it does not affect the structure, but if it happens that the dam fills up, it decreases its value, and it is an element of depreciation. In the case of the Chabot Dam of the Peoples Water Co., it was a very small amount, according to Mr. Cory's figures as to silt, which I appreciated. There were some measurements in that case which showed that it would take 7923
a good many years to fill up, which made it too remote for practical consideration.

(Mr. Dockweiler here stated that he had made an investigation as to silting with reference to the Spring Valley Reservoirs, and it would be so long, that it can be ignored, but that with relation to the Chabot Dam of the Peoples Water Co., it was estimated that it would take 100 years to silt up).

Mr. Hazen: In the tunnels where I changed from brick to con- 7924
crete, if I had estimated them as brick in the first place, I think I should go through the same process as I do with the Upper Crystal Springs Dam, that is, I would depreciate them by obsolescence, or to a certain percentage, but I shorten the process by estimating them in concrete.

Questioned by Mr. Greene.

I do not think that there would be depreciation in the tunnel lining; it might be depreciated by a movement of the earth, or some-

thing of that sort, but practically any depreciation would be functional. I have allowed some depreciation on several of the tunnels owing to changed conditions since they were built. That assumes that the work is well done. If there was any depreciation of that kind, I think it ought to be apparent on physical examination, and in that event, allowance should be made for it, but I am speaking of tunnels in good condition that show nothing of that sort. Structures of this type must be looked at from the standpoint of their usefulness, conditions and probable serviceability, and depreciation, if allowed, must be based upon conditions of this kind, and not upon the age of the structures.

I may say, in connection with the dams, that there are various
7925 perishable items, the houses and the woodwork, and the iron pipes, and the gates, and so on, and I have usually allowed depreciation on the perishable auxiliaries of the dams, but not on the dams themselves.

Merced Structures: These include a pumping station, pipe line, and various protective and auxiliary works for making Merced water available. Depreciation on them is estimated in the ordinary way, as if Merced water was to be continued in use indefinitely. It may be thought that if Merced ceases to be used as a regular source of supply in a few years, that is, after Calaveras water is available, that the present work will no longer be needed, and that for the emergency use of Merced thenceforth proposed, other and different works will be needed, and that in view of this condition the Merced structures should all be depreciated, regardless of their physical condition, as if their life were nearly run. I do not accept this view.

The sole reason for giving up the daily use of Merced is the great increase in the value of the lands needed to protect the quality of its water. The time seems to be approaching when it will pay to sell off this land for building lots, and get an equivalent supply of water from a cheaper source. It will only be best to do this when the lands alone can be sold for more than the whole supply is worth for water; that is to say, when they can be sold for more than the sum of the estimated cost of the reproduction of all structures, less ordinary depreciation, and the water rights, and as much of the value of the land as a return can be earned upon, at rates otherwise fair, in the water supply business. When the land can be so sold, and is so sold, it will,
7926 obviously, be at a profit that is large enough to absorb any remaining value in the structures and water rights that there may be. It should be so absorbed, and no additional depreciation on structures should be allowed so long as the structures remain in daily service. That is, when the Merced is finally written off, it will not be a charge against depreciation on structures. If it is sold, it will be sold because it is more profitable than to continue it in the water supply business, and that the profits of the transfer ought to absorb any incidental losses that there may be.

Questioned by Master.

Referring to my explanatory sentence, reading "and as much of "the value of the land as will return", and so forth, my thought is this: Here is a property which was a very desirable source of water supply when it was acquired, and, apparently a very economical one in its time, and it served and is serving an excellent purpose, but the time is approaching when it will be best to sell that off and give it up as a regular source of supply. The greater part of investment in Merced is in land for protective purposes. As far as the lake is concerned, and a limited margin around it which would give control of the water, that only represents a value at the present time which is so moderate that it would be worth while to keep it for water supply purposes, but to limit the supply to that would mean that all the surrounding lands would pass into other ownership, and be used for 7927
other purposes. The water would be polluted, and so it would not be proper to continue to use it.

The point of this is that the depreciation at Merced, which would be functional, if it were to go out of use because it were not suitable, for instance, because it were bad water, if that were the case, would put it on an entirely different basis than because it goes out of service because it has become more valuable for another purpose. I have estimated the normal depreciation; that is, I have estimated a depreciation just as if it were going on indefinitely. Of course, when it would go out of use cannot be foretold. The system could not be operated without it at present—and that applies to some years in the future, just how many I cannot state. My theory only applies when it is entirely clear that the substituted use is a more valuable one. In other words, when the speculative value of land becomes greater than any reasonable return that could be earned on it, then the company will turn around and sell the land as a real estate speculation, and give up the water business so far as that goes. Until they do that, the people 7928
can continue to pay rates on the value of the land and the water there; that would include an ordinary allowance for depreciation, but it would not be fair to make an extraordinary allowance for depreciation, because of the increased value of the land for other purposes. This is a case where omitting depreciation would apparently do little harm, but I think it is better to stick to the ordinary custom, and treat it as waterworks property on the ordinary basis as long as it is worth while to keep it in service.

DIRECT EXAMINATION BY MR. GREENE.

Depreciation on minor items is estimated in general upon the same principles as those relating to large structures of the same character. Condition was frequently taken into account, and the estimate was based on it. The trestles are usually estimated to have a 40-year life, corresponding to the flumes.

At the San Andres Reservoir the outlet works were damaged by the earthquake of 1906. Since then new structures have been built which practically replaced the old ones. A heavy depreciation is allowed on the old ones, but not 100%, because the old structures have been repaired, and are connected, and still have a certain value for reserve service. That is in Table 3. I allowed 70% depreciation
7929 on the old structures. A depreciation of 20% is allowed on the Bald Hill Tunnel. The tunnel is in good condition as far as the service for which it was built is concerned, but some reconstruction will be necessary in connection with the enlarged service to be expected in the future from the San Andres Reservoir. I don't feel quite sure that I ought to have made this 20%; it may not be quite fair to depreciate a good structure, simply because something else is going to be done. What I have in mind is that the Calaveras water will be brought to the city by way of San Andres, and that will involve cutting some new connections at San Andres, which will make quite a difference with the present outlet. I am not sure that that ought to be allowed as depreciation, but at any rate, I marked it off in that way, and that is the reason for it.

The composite pipe line serving as rising main from the Crystal Springs Pump is depreciated rather heavily. That is the last item on Table 4, amounting to $36,100, depreciated 40%. This was built
7930 to meet an emergency, using stock on hand, and there is much more than the normal amount of material in it; they used old pipe and fittings that they had in the yard, and put them together quickly to get this line which was needed to save some water.

Much of this material can be taken out at some subsequent time, and again used in the system. The allowance for depreciation was based on a consideration of the cost of a new single line to render an equivalent service, but with an addition for the probable salvage value of some of the parts in the present line, and the depreciation was taken as the difference between the cost of reproduction of the line as it is, and the amount so found.

The Upper Crystal Springs Dam has ceased to be useful as a dam. It still carries the road and takes the place of a bridge. It has the further function of keeping the turbid water in the upper basin from mingling with the water in the other basin from which the supply is taken. The cost of a simple fill to carry the road, and keep the waters separate, is considered, with the necessary culverts and gates, and depreciation is taken as the difference of the amount so found, and the estimated cost of reproduction of the structure as a dam. In other words, the depreciation is assumed to bring down the cost of reproduction in the estimate to the cost of a simple roadway and earth fill to keep the waters separate.

The tunnels on the Crystal Springs pipe line are built as part of the pipe line, and probably would not serve another line at some

future time. I think if a new pipe line were built, it would probably be built before the present line was abandoned, and parallel with it, and new and parallel tunnels would be driven in connection with it; it also probably would be larger than the present line. It is 7931
doubtful if they will be of use after the present line has reached the limit of its usefulness. They are, therefore, depreciated at the same rate as the pipe, even though there may be no physical deterioration in them.

On the composite pipe line to Ocean View, made up of old pipe, with some thin steel pipe, the estimated cost of reproduction is based on a simple line equivalent service, and depreciation corresponding to a life of 20 years is taken. In that case, the old iron pipe I estimated as equivalent to a new steel pipe, and I took the price of a new steel pipe which they bought as covering the old one, which as a strict matter of reproduction, would cost a great deal more than the steel pipe, and more than I have estimated. The short life is taken because that is steel, and it is also thin, and I don't anticipate that it will be a long-lived structure.

The San Mateo Screen Chamber, 13 years old, is depreciated on the basis of an assumed life of 30 years. It should be as durable as the flumes, but there will be considerable replacing of the fittings.

At Millbrae, the reservoir built near the stand-pipe is not in service, and is not likely to be used. Very heavy depreciation was estimated on it, and on some of the other structures. It is doubtful if these will ever be used, but some salvage on the gates and pipes should be obtained. Those are very small items.

On the Honda Tunnel 20% depreciation is deducted on the ground that the tunnel is not large enough or low enough to be fully 7932
adequate for service for some time in the future. From the standpoint of present conditions, this allowance is not warranted, for the tunnel is performing all its functions satisfactorily. That is in the same position as the Bald Hill Tunnel. A much larger connection with Honda will be needed in connection with Calaveras water, and that Honda Tunnel will simply serve as a reserve after that. They may have to tunnel under the Twin Peaks Tunnel there. They can put in a pressure tunnel. I have not worked that out, but some way will be found to get there.

The Sunol works are of permanent construction, and there is little occasion for allowing depreciation on them. I have made an allowance corresponding to lives of from 40 to 55 years, corresponding to remaining lives of about 40 years. They were built at different times, and I varied the allowance according to the ages, and assumed them all to be written off in 40 years in the future. I think perhaps that deduction ought not to be made. The deduction is justified only on the theory that the whole business of handling Alameda Creek water may be so changed at that time as to reduce the usefulness of

those structures. The deduction is a debatable one, and perhaps should not be made. It amounts to $44,000. So I would take that off now, and that will offset the one that I added before.

7933 On the Niles Aqueduct the dam and masonry aqueduct are in perfectly good condition, and the 5% depreciation allowed is nominal. A steel bridge, left without connection by flood, has only salvage value.

The submerged pipe lines at Ravenswood have been depreciated upon the basis of an assumed life of 50 years. These pipes, as far as can be discovered by examination, are in perfect condition at the present time.

At Honda the main structures are depreciated 10%. I have not usually depreciated the reservoirs, but the Honda Reservoir was built at various times, and on different plans, and while the whole has worked out well, it is considered that the material is somewhat less advantageously disposed than would be the case in a modern structure.

The Francisco Street Reservoir is depreciated 40% on condition. The reservoir is in use, but it is only moderately serviceable at the present time with reference to what a reservoir of that size ought to be capable of. Such use as is made of it is indispensible, and the system could not be operated without it at the present time. The reservoir, as it stands, would serve as the beginning of the construction of a modern reservoir, and the work done on the embankments, and so on, would go a long way toward building such a reservoir. The 40% depreciation was my judgment; it was my judgment that the reservoir was fairly worth
7934 60% of what the items in the schedule came to, taking into account its present necessary use as part of the system, and particularly on the work which they would represent on the construction of a good new reservoir.

The other distributing reservoirs are in good condition, and only nominal depreciation is made on them. By nominal, I mean depreciation on the auxiliaries, the deteriorated part, and not on the permanent parts.

Three stand-pipes in the system have been depreciated by the Sinking Fund Method upon an assumed life of 50 years. Two of these tanks are built of steel plates, and the Clay Street tank of wrought-iron plates. By the more detailed analysis, there should be a separation in the lives allowed, the probable life of the wrought iron tank being greater than for the steel one. This matter was overlooked, and 50 years is taken as an average for all.

That completes the description of the methods that I used in reaching the depreciations that are entered on this table. In my judgment they represent the depreciation, and all of the deprecia-

tion, that has accrued, and ought to be allowed, in the existing structures in this system.

I now come to annual depreciation, by which is meant the 7935
amount that must be marked off each year to make up for all the losses of wear, tear, corrosion and abandonment of physical structures.

One way of forming an estimate of the annual depreciation is to go through the items of the inventory, and assign to each a certain rate corresponding to the assumed expectancy of life, as arrived at by the estimator in some other way. Such a rate is necessarily arbitrary, and sufficient reasons for it at all points cannot be advanced. It is especially unreliable in that the times when the various parts of the plant will cease to be serviceable cannot be known in advance, and any estimates made are likely to prove wide of the mark.

I have made a serious effort, extending through some years, to get another and better guide in estimating annual depreciation, based on the experience of old works, which had been examined in considerable detail, and for which tolerably complete financial history were available. Data of this kind are very hard to get. In three of the cases to be mentioned, Mr. Metcalf is principally responsible for the financial histories that I have used, although not for the final arrangement of the data. The plants are plants that I have had to do with, and have valued, and so in saying that I am endebted to Mr. Metcalf for the financial history, I do not mean that I am endebted to him for the whole data, by any means.

Method Followed: The total depreciation is made up of two 7936
parts, namely, the cost of all structures that have been discarded in the system from the beginning of operation to a given date, and the amount of accrued depreciation in all the existing structures at that date. I am referring to the original costs there. There is a certain discrepancy in these figures, because costs have varied through a long term of years, and there has not been any way that the data could be brought up to the same basis. For instance, most of these works go back to an early period when materials of construction were very high. I will speak for the East now; in California there were probably somewhat similar fluctuations, although not in the same percentages.

With the Eastern works in the seventies, cast-iron pipe sold for $70 a ton, or so, and the early construction was very much more expensive than anything in recent years, and from that time until in the nineties, there was a very great drop in the cost of materials of construction. When I first had to do with the valuation of water-works plants that were being taken by cities, the costs of reproduction as measured by the costs at that time

were very much lower than the actual costs of the plants. That was always the case with the valuations that were made at that time, the cost of reproduction was a very much lower basis than original cost. From the nineties, in the last 20 years, speaking broadly, the costs have been going up until the costs of repro-
7937 duction are very much greater than the actual costs of work that was built at the lowest swing of the tide in the nineties, and these records that I have are through those swings, and of course they represent work built at different periods, and at different relative costs. It has not been possible to straighten this out, and the data is all subject to the objection that they have not been straightened out; but notwithstanding that, I think it is very significant and helpful.

The whole depreciation, then, is made up of two parts, of the cost or worth of the discarded structures, and of the accrued depreciation at the date of the inquiry. The depreciation so found must be referred to some base, and several methods of doing this suggest themselves. The first method which I consider is this: The depreciation may be reckoned on the total costs of the structures, new. This method has much to commend it, and it is in line with the ordinary method of reckoning depreciation. It is open to the disadvantage, as a practical matter of procedure, that it is necessary to carry two accounts forward in applying it, namely, (a) an original cost account, (b) the same less depreciation. The difference between the two represents a depreciation fund, and the annual depreciation is made up of two items, first, the annual depreciation as ordinarily computed, and second, the interest on the accumulated depreciation fund to that date. The complexity of the computations that are required are somewhat against the method.

A second method which I considered is to reckon the depreciation on the cost, or estimated cost of reproduction, less depreciation for the preceding year. This method has the advantage of simplicity.
7938 It is open to some objections, as it probably results in marking off more depreciation in the early years of a property than should be marked off, and somewhat less later on. On account of its convenience, and notwithstanding this defect, it will be used in that which follows.

Then I used a third method. Depreciation may be computed as a percentage of the gross income. This method has the advantage of making the allowance for depreciation small in the early years when the income is small, and of increasing it with the income. This is certainly a logical procedure. It is open to the objection that with an unduly low rate of return, the percent of depreciation must go higher than normal, and with an excessive rate of return, it must be lower than normal. There may be some practical difficulties, therefore, in adjusting the matters on this basis. I have studied it more,

and am disposed to use it rather more seriously as I study it more. It has some very practical advantages.

Portland, Maine: There were 4 water companies, all in the same 7940
ownership, and doing business together, and they were all taken at the same time, and the accounts of the 4 companies have been consolidated in making this statement. The plant had been in operation 39 years at that time, and had done a profitable business; it was a good plant, but there had been a good deal of depreciation on it, in part owing to lack of adequate engineering advice, perhaps, and in doing some things that were not very well advised. The plant was taken under a condemnation proceeding, but the value of the physical parts of the plant are agreed upon by 4 engineers, 2 representing each side, and I have used the figures so agreed upon. The depreciation was not agreed upon, but I have used for this purpose the average of the estimates of the 4 engineers as being the fairest basis. The Court made no determination of the amount of depreciation, so I could not use that. The depreciation on the existing structures—following Portland through first, before I take up the other plants—was \$498,000, and the abandoned structures was \$136,000, plus, and the total depreciation, the sum of those items, \$633,000. The cost to reproduce the structures in use at the time of the valuation was \$2,594,000, and adding the discarded structures, the cost to reproduce all would have been \$2,731,000, and deducting the depreciation from that left, for the existing works less depreciation, \$2,096,000. The last year covered by the records was 1907. The average age of the existing structures was 18 years. These next lines are made as a calculation to show the gross amount of investment for one year, less depreciation. We studied it for some time, and this was the form 7941
that seemed to put it in most compact form.

I took from the cost of reproducing all the structures, \$2,731,000, one-half of the total depreciation, \$316,000, and that leaves \$2,414,000 as the cost of reproducing the structures, less half the depreciation; we have the depreciation referring to half the age, starting at full value at the start, and coming down to the \$2,096,000 at the end, and averaging for the whole period, the gross amount less half the depreciation. That was not based on a ratio of 18.39. It has nothing to do with that. At the beginning of the life of each structure you have 100%, and at the end of the life you have, let us say 60%, and during the whole period it will average 80%; in other words, during the whole period under consideration half the depreciation will have accrued; the whole has accrued at the end, but starting at nothing at the beginning, the average will be half the depreciation off. Multiply that by 18 years, the average age of the structures, and it gives the investment as equivalent to \$43,500,000 for one year.

There is one assumption involved in this which does not rest upon any data, but which I think is fair; the abandoned structures

are assumed to have the same average age when they are abandoned as the existing structures, that is 18 years. I had no basis for computing the average age of the abandoned structures, but those abandoned structures were the earlier structures built, and were the less durable ones, and their life certainly was a great deal less than the normal life of the remaining structures, or of all the structures in the plant. So, the error involved in assuming that the average life of these abandoned structures was 18 years, I think, was not very great.

7942 We have this investment of \$43,500,000 for one year, and a total depreciation of all kinds of \$633,000. Dividing that by the \$43,500,000, gives 1.46 as the average annual rate of depreciation of the structures. In other words, if the company had started, and marked off the first year 1.46% of its construction account, and had added each year its construction account, and deducted 1.46 of the balance at the beginning of the year, if the calculation is right, the construction account at the end of the period would balance up with the \$2,096,000, the estimated cost of the construction, less depreciation. The Portland plant had earned from the sales of water altogether \$6,605,000, and the whole depreciation was 9.57% of the total water sales. I think the depreciation on the Portland plant was a good deal above the average owing to some rather expensive construction that had been carried out, and that was not very useful, and I took that into account in applying it in this case.

Racine Water Co.: The record, going up to the end of the year 1913, when it had been in operation 26 years, the average age of the existing structures was 16 years; the depreciation on the Racine plant has been unusually small for two reasons. The first is that it was a very well designed plant, anticipating very well all the growth that has actually taken place, and practically nothing has had to be discarded up to the present time; and the depreciation is low in the second place. Next, the water handled by it is Lake Michigan water, which is usually clear and free from organic matter, and fairly alkaline, and which has very little corrosive effect on the pipe. The waterworks system handling the water of the Great Lakes suffers much more depreciation than plants that handle the softer river
7943 waters; there is quite a marked difference, and the depreciation on the pipe system at Racine is very low.

Denver plant: This plant was made up originally by the consolidation of several water companies that were in competition with each other, and there was quite a little discarded material that grew out of that separate construction, and subsequent consolidation, and the depreciation is further somewhat high because wood stave pipes had been used in the main lines, and the life of these pipes is comparatively short.

In the last column I have the data for the Spring Valley Water Co.: The depreciation on existing structures, \$3,192,000, as summed up

in this Exhibit 97, and the abandoned structures estimated at \$3,300,-000; that is Mr. Sharon's figures, which he dug out at well as he could from the old records, giving a total depreciation of \$6,492,000 in the whole history of the works. The cost to reproduce present structures, \$25,125,000 is also from my Exhibit 97. That is subject now to a little modification, by reason of the agreement on certain schedules; I have not corrected for that. The cost to reproduce all the structures, adding the \$3,300,000 to it, is \$28,425,000, representing the whole investment in structures for the whole life of the company, and less depreciation, \$21,933,000. The period of operation is 55 years, to the end of 1913; the average age of structures 26 years; the cost of reproduction of all structures, present and abandoned, less half the depreciation, \$25,179,000, and the equivalent investment for one year, \$654,000, and the corresponding annual rate of depreciation 0.99%. The total income from sales of water, \$76,967,000, and the depreciation equal to 8.45% of the gross sales. I think, in several of these cases, the amounts received from the sale of water in some of the
earlier years were not quite sharply set off; either there was some 7944
uncertainty as to the income for certain periods, or there was an uncertainty as to the classification of income between sales of water and income from other sources. I have tried to get the best data available, but in some cases it has been necessary to estimate some things to round out the record.

That is gross for the entire life of the plant, and I think includes the impounded moneys. The average rate of depreciation, reckoned each year on the estimated cost of reproduction, less depreciation for that year, as deduced from the four plants, is 1.06%. The average
depreciation for the four plants is 1.06% per annum on the estimated 7945
cost of construction, less depreciation, or by the third method, the average is 9.28% of the gross income. I do not think the averages ought to be used too widely. That is, the differences in the plants ought to be considered in applying them, and there are quite considerable differences between these different plants.

This data that I have collected, obviously, is more or less imperfect for purposes of this discussion. The depreciation in the future, and the depreciation in the recent past may be quite different from what the depreciation was long ago, and the basis of the estimates, and of the costs of the construction at different times has undoubtedly varied widely, and these matters are not fully taken into account in this calculation, and I do not very well see how they could be. The cost of reproduction, and the amounts allowed for depreciation are estimates, but even so, it seems that this data itself gave a rational basis, crude though it is, for getting at depreciation, that is real value, and that is a good deal better than amounts computed out of one's head by mental processes out of assumed ages for the different

parts of the structure, where there is no basis for knowing what those ages are.

The sinking fund disappears in this final allowance of 1%. There is not any sinking fund, and there is not any straight line. I don't know that the method has been named. Mr. Kiersted, an engineer of Kansas City, was very much interested in this general method years ago, and I think probably I am indebted to him for a good deal of suggestion in regard to it. As far as I know, he never
7946 had data like this to put it in shape; he used to do it as a way of getting at it. As I have been thinking about it the last few years, I have been trying to get hold of data of that kind to show what the whole depreciation had been, and to get some basis on which it could be expressed or applied in every case. It does not assume a constant ratio between gross income and investment in property. These are really two independent methods of handling the data, and if the ratio between the cost of reproduction and income varied, obviously, applying the two methods would not give identical results; there are two different methods of handling the data. They would not be widely different results, because the ratio of return on investment isn't one that varies widely, but as it varies it would make a difference in the two methods; which would be the best, I think, would be open to debate.

Questioned by Master.

Mr. Metcalf stated for me this morning that I had concluded in this case 1% of the depreciated reproduction cost as the basis for my annual depreciation increment, and that is what I had on some of my earlier calculations. But I have since gone through it, and I have perfected this last study, and I am disposed to take the second base as a basis for many calculations that I shall have to make. On that basis the depreciation comes to 8.45% of the gross income of the Spring Valley business, and I am disposed to consider that as perhaps as good an indication of depreciation as I could suggest at this time.

7947 Questioned by Mr. Metcalf.

That amounts to more than 1% on the other base right now, with the plant underbuilt, but when the Calaveras works, for instance, are built and brought into service, with a great increase in the invested capital, and without a corresponding increase in income, then it throws it the other way; it puts the distribution between different years somewhat differently.

Questioned by Mr. Searls.

I am looking at this as a practical matter as well as a theoretical one. Let us suppose that we go ahead and build the Calaveras works, and put $10,000,000 of new money in it; that means that you have $100,000 extra depreciation to meet right off, and it comes at a time when the system cannot well stand an increase; taking it on the other

basis means that when the Calaveras works are built, there is no immediate increase in depreciation, but it goes on increasing gradually as the income increases. I am inclined to take it as a practical matter that this may be a fairer way of distributing it. This is new business. We have just been working it out, and we are trying to get hold of the rational way of handling it, and I am not setting up either of these methods as less worthy, or anything approaching it; it is just a good serious try to get a better basis for getting at it.

Questioned by Master.

My annual increment was $219,000. That was on a 1% basis. 7948

If either of these methods had been applied from the start in 7949
this case, disregarding the difference between reproduction and cost, if either one method had been followed constantly from the start, the accrued depreciation shown by them would correspond with what I have estimated, so that I think they are fully in harmony. As a result of my other studies which I made, I came to the conclusion, at least 10 years ago, that the average rate of depreciation on American waterworks properties was in the neighborhood of 1% per annum, that not being a fixed figure, but an average figure in which there was considerable variation; figures of considerably less than 1% were found in various stable properties, and running up to 2%, or more, in properties that were not stable and well designed. In other words, I would use 1% as a basis, and vary it more on the impression of the plant as to its durability and desirability than upon the calculations that had been made on the lives and the sinking fund.

ONE HUNDRED AND NINTH HEARING. MARCH 3, 1916.

Witnesses: Allen Hazen for Plaintiff.
Leonard Metcalf for Plaintiff.

Witness: Allen Hazen for Plaintiff.

DIRECT EXAMINATION BY MR. GREENE. 7951

I think I can define salvage value a little more accurately than I did yesterday. I should consider the salvage value to be either the value of the pipe after relaying, less the whole cost of taking it up, and doing everything that was necessary to it in relaying it, or the value of the pipes taken up in the yard, less the cost of taking it up and putting it in the yard. The two would nominally be the same thing.

If it developed that the rates during the years in controversy, 7952
and possibly before that, were eventually shown to be confiscatory in that no depreciation was allowed for the years in controversy, I do not see how any wrongs or conditions of the past would affect the

cost of reproduction, or the amount of depreciation that should now fairly be allowed; it seems to me that if there were wrongs in the past, and charges in force that were not equitable, that some other way of correcting it would have to be found, if such a way could be found. It might result in a basis for a claim of the company that the rates should be higher for a certain period to make up for what they had been lower in the past. My figures include the impounded moneys. As far as my calculations were concerned, I used the whole income, including the 15%. I misunderstood your question. I understood it to relate to this question, supposing the whole income, including that, turned out to be so small that it would permit the proper depreciation to be marked off, in that event what would happen to that deficiency? I say, as far as I can see, that would not affect the value of
7953 the plant now, but would rather result in an equitable claim that the depreciation for the next five years, for instance, or some other period, might be made higher to make up for what it had not been possible to have it for the last five years. I suppose that if the rates should be found to be not confiscatory, and the impounded money returned, the corresponding equitable reduction should be made.

Questioned by Master.

I don't think I am able to say whether, if in the years past—that is preceding 1907, the community has not proceeded on the theory that accrued depreciation must be provided for in rates to satisfy the community's obligation to keep the company's capital intact, that we should then begin at some time, by system of annual payment on account of depreciation, to make up not only for thereafter accruing depreciation, but for that which has accrued in the past. I do not think I am able to say whether there is an obligation to correct the wrongs of the past or not; at any rate, that has not entered into any
7954 treatment of it that I have in mind. It seems to me that it is something that might fairly be considered. Whether there is an obligation to allow it or not, I cannot say. The Knoxville decision, as I understand it, is that it was the duty of the company to charge rates that would permit it to mark off a proper amount of depreciation. It may be that the Spring Valley was in a different position in that the rates were fixed for it, and that it had no opportunity to charge rates that would permit it to take care of depreciation. I am not prepared to say whether in determining a question before a court we shall start in and amortize that lost depreciation beginning 1907.

What I did in effect in my system was to make the amount of deduction from reproduction cost new, represented by depreciation, equal the total of assumed depreciation from the beginning in annual
7955 installments. I followed two systems in handling the same depreciation; if the calculations are correct, as I intended to make them, that is the base. My total includes abandoned structures, and it makes a large difference.

Questioned by Mr. Metcalf.

I did not mean to imply that my figure for accrued depreciation of $3,000,000 and something over included the abandoned property. That is the depreciation upon the existing property, so that the total depreciation today would be the sum of that and the abandoned property. That is the amount to be accounted for.

Questioned by Master.

The total accrued depreciation, $3,192,000, upon the existing property, would not necessarily be found by multiplying 1% by the 7956
average age of the existing structures.

It is true that if I took one of the more complicated systems, like either the Pure Sinking Fund, or the equal annual payment method, that I would have an exact correspondence between past depreciation, paid in annually, assuming it was so paid, and the amount of my reduction from reproduction cost to get present values, taking into account figures on discarded items as well as the depreciation on the present items. That assumes that cost new, and reproduction costs are the same. That is a defect in the calculation; there are probably others, too. It is not as definite as we would like, but it seemed to be the best we could do. The great advantage is that it substitutes facts and records for speculation.

Neglecting for the time the reckoning of depreciation on gross 7957
income, and taking it the other way: I get $3,192,455 as the depreciation on the existing structures; I determined that, not by any estimate of probable lives, but by inspecting the property and considering its physical condition, and the extent to which its life or existence appears likely to be affected, either by obsolescence or inadequacy, or any form of functional depreciation, and to that extent that part of it is an actual inspection method. Then I determine my cost of reproduction, and my cost of reproduction including my abandoned structures; then I determine a figure of $21,000,000, which is the result of taking from $28,000,000 the existing and abandoned structures, minus the $6,492,000, which is the abandoned structures, plus the existing depreciation. It results in the same thing, as substracting $3,192,000 from $25,125,000, because I have taken $3,300,000, the amount of abandoned structures, as being the cost of reproducing them. That is an assumption, but that is the method.

Mr. Searls: Q. I see how you could get original costs from the 7958
records, but I was wondering how you could make any dependable appraisal of the structures? A. Well, that will have to go for whatever it is worth.

Questioned by Master.

In that figure I have just taken original cost, and I then determined the whole period of operation in years to be 55. The average age of existing structures, 26 years, was obtained by taking the age of each of the structures, or classes of structures in the inventory,

and multiplying the amounts by the age, and then dividing those products at the end by the sum of the amounts. That is an average life method.

Mr. Metcalf: I check that figure.

Mr. Dockweiler: I did not.

7959 Mr. Metcalf: As a check on that, we had a diagram of the rate at which the pipe was laid, and we found it in that way; in other words the pipe mileage.

Mr. Hazen: At any rate, that is calculated from existing structures. Then I assumed that the $3,300,000 of abandoned structures were also 26 years old when they were abandoned. The age must be less than 55 in every case, and in many cases a good deal less than that. I have not statistical basis for getting at that, and so I just assumed that the abandoned structures when abandoned have the same average age as the existing structures now have.

I don't see that that makes cost a function of the life. Then I get costs, less half the depreciation, including the abandoned structures, as $25,000,000, and multiply that by the average age, and then I get the percentage that that bears to $6,492,000.

7960 Mr. Metcalf: I have assumed that on the abandoned structures the abandonment occurred, probably, for the most part in comparatively recent years, that is, after the period when the growth of the works began fairly rapidly. A good deal of that abandonment was due to obsolescence on the very early structures, the very small ones. The Upper Pilarcitos we have depreciated fully. The Locks Creek is one example of flumes.

Mr. Hazen: That is a matter of speculation; I would doubt that the average age of the abandoned structures was more than 26 years. I don't know of any way that I could settle that. I took the obsolescence of all structures, with the exception of the Merced structures, into account when I made that estimate as to probable life.

Mr. Metcalf: When you made your statement that it was likely to be shorter, Mr. Hazen, did you bear in mind the fact that the Pilarcitos pipe line went out in the earthquake? That is a pretty large
7961 element in the abandoned structures. It seemed to me that the effect of the earthquake would tend to make the life longer, beause the earthquake was recent.

Mr. Hazen: That Pilarcitos line was laid in 1867, and it went out in 1906; that was 39 years.

Mr. Dillman: But that was only partially abandoned, because most of the pipe has been used in other parts of the system.

Mr. Metcalf: Some of it was used, but the labor was lost.

Mr. Dockweiler: You must note that the long Pilarcitos flume, which originally came down San Mateo Canyon and encircled Sawyers Point, and then came back, was at a relatively early stage of the works. Then there are to be noted the Potrero Reservoir, and the

Islais Creek properties, which were abandoned in the early sixties. The Pilarcitos water came in in about 1861. That necessitated the abandonment of structures which had hardly served over three years. I am inclined to hold with Mr. Hazen that if anything those works had a lesser age.

Mr. Metcalf: I will go a little further into that, and see if the records are sufficiently complete to make an accurate computation as to that.

Mr. Hazen: Generally speaking, the abandoned structures would have had much shorter lives than the remaining ones.

Witness: Leonard Metcalf for Plaintiff. 7962

DIRECT EXAMINATION BY MR. GREENE. Metcalf

As bearing upon the question of the consideration which should be given to the fact that in the past a proper allowance for depreciation had not been made, if such were the fact, it seems to me that we have a parallel in the case where the works are operating, let us say, under normal conditions, with a fair rate of return, and where it becomes necessary to undertake important additional construction which will make necessary the investment of such an additional amount of capital that it will not be possible to earn on the existing rates a fair rate of return. Under those circumstances, it has seemed to me that public policy, and certainly what is desirable from the point of view 7963
of the company, would dictate the continuance of existing rates if possible, even though that necessitated the temporary suspension of charging to depreciation allowance proper amounts, on the theory that subsequently, that is, within the period of a few years, the revenue would have grown in such a way, as the result of the new business which demanded the new construction, as to carry the additional burden. Under those circumstances it seems to me it is clearly equitable to allow later on additional depreciation to take care of the allowance which has not been made in the past.

It seemed to me at the time the Knoxville decision was rendered, if proper depreciation had not been made in the operation of any waterworks plant—and it is a fact that very generally waterworks did not lay aside depreciation funds in those days—it would have been equitable to take that into consideration, and to have based the depreciation allowance order on the anticipated future conditions, and to have increased the allowance above the amount which would have been required if sums had been laid aside to the depreciation account; in other words, to treat the problem rather as one of maintenance than of laying aside a depreciation fund. With the lapse of time since that decision, it has seemed to me less and less equitable to assume that the corporation could recover any depreciation which had not been pro-

vided for in the past, except in so far as the problem might be influenced by the consideration of additional construction.

It would seem to me that the excess which you had earned should not be attributed in the past to excess depreciation allowance, but to excess rate of return which you would earn; in other words, I should
7964 subtract from gross earnings which have been earned on any plant, the operating expenses, including the taxes and maintenance and the fair depreciation allowance, and should assume that all the rest was return. Under those circumstances I should not deduct from the depreciation allowance any excess which had been earned through the agency of rates. I should consider it, and should place it as a question of a fair rate of return.

Mr. Hazen's depreciation allowance was reckoned on that very revenue when he assumes it, and it is a part of the depreciation allowance so far as you consider it solely from the point of view of being a percentage of the gross revenue. I don't understand that Mr. Hazen has used that as the sole criterion. He has done, I take it, what I have done in a number of cases with clients who have asked what was a fair allowance to lay aside. I have figured it by various methods, and summed it up as a matter of judgment, and then told them to lay aside a percentage of the gross annual revenue for a coming series of years which would produce that sum on the theory that in that way, automatically, you would provide an increasing allowance for depreciation with the growth in the business, which means, of course, also the growth in plant to take care of the business. It is a very much simpler method of accounting it, and from that point of view it is advantageous. I think it is probably true that the result should be checked up from period to period, maybe 5 or 10 years, in order to make certain that it is not doing injustice to one side or the other.

7966 The depreciation of structures has been considered by engineers and accountants from two substantially different points of view; first, that of their ability to serve; and second, their longevity.

On the service basis depreciation may be defined as the loss of value in service of the existing as compared with a similar new structure.

On the longevity basis depreciation may be defined as the loss in value of the existing as compared with a new structure due to elapsed time.

Under the service idea there is to be deducted from the value new of the property in determining value, an allowance only for deferred maintenance resulting from a temporary failure to maintain the property at 100% service value.

Under the longevity theory there must be considered the loss from the value new due not only to wear and tear or physical depreciation, but also functional depreciation and the mere lapse of time. Whether or not this depreciation allowance must be deducted from value new

as a basis for rating depends upon the method of accounting depreciation. If the depreciation allowance is treated as amoritization of capital and all renewals are treated as new construction then deduction should be made from the value new of the accrued depreciation to determine the rating base.

If, on the other hand, the depreciation allowance is treated as a fund to be used solely to renew structures as they suffer total depreciation or have to be replaced from any cause no deduction should be made from the value new in determining the rating base.

In its final analysis the determination of depreciation is essentially and clearly a matter of sound judgment which should be based in large measure upon the actual existing condition of the structure
so far as it can be determined, the probable future conditions of ser- 7967
vice, so far as they can be forecasted, and the equitable consideration to be given to the method of accounting depreciation under which the property is operated.

No method of figuring depreciation thus far adduced can be applied to all cases or structures with equity without modifications to accord with special circumstances, conditions and facts. All methods are subject to serious error and abuse unless controlled by fair minded judgment.

Finally, the depreciation allowance should be weighed from a consideration of what appears to be a safe allowance for maintaining the integrity of the investment in structures from the investor's point of view and what may be desirable and fair from the consumer's point of view.

I should say at this point that I have made as careful an examination as I could of the structures, walking over many of the flumes, examining the materials to be found in the pipe-yards and going through or making entry into a number of the pipe lines.

I have also had the data to which Mr. Hazen has referred in regard to the frictional loss in various mains, which bears upon the carrying capacity of those pipe lines. I have, of course, had information from various men, particularly Mr. Lawrence and Mr. Sharon and some of the men at the pumping stations, in regard to the condition of the structures and in regard to the pipes at points where they have been entered and pieces or sections cut out for one reason or another, as for instance, making connections with new lines.

Of course, the character of the construction, whether it be of a permanent or temporary kind and the excellence of the work plays an important part in limiting the rate of depreciation. In that respect, as has already been pointed out by Mr. Hazen, these works
stand in a very good light, the structures being for the most part of 7968
long-lived character, well built, with a view to long life and to low operating costs.

Of great importance also is the character of the upkeep of the plant. That is particularly true of the flumes. If, for instance, the water is not kept in the flumes, or if they be built upon the ground instead of being properly blocked up, it substantially shortens their useful life; and in the same way, the care of the buildings and the other structures, the painting of the buildings and the fences and so on, tends to prolong their life. In that respect, so far as I am able to judge or find out about it, the practice of the company has been very good. The abandoned property record seems to me also to be of significance in a discussion of depreciation.

In figuring depreciation upon this plant I have used various methods as will appear hereafter; first, the sinking fund, using 4% rate of interest. I think that the tendency of the time is distinctly toward the use of a 5% rate instead of 4 upon the theory that the sinking fund will either be invested directly in the renewal of the structure or else in new construction and that money is obtained under issue of the bonds of the company at a rate perhaps approximating 5%.

On the other hand, in my past experience I have used 4%, so that I am familiar with that; that has been my yard-stick for some years and so I have used it here. It tends to make the depreciation allowance heavier than would be that found by the use of a 5% rate.

I have also figured the depreciation upon the same assumptions as to length of life upon the straight line basis in accordance with the Master's request. It does not seem to me that the results obtained are fair or significant primarily for the reason that under that
7969 method of accounting you fail to take into consideration the value of money; in other words, the interest element.

If you were to value the plant today on the basis of gross reproduction cost and were to turn over a fund commensurate with the accrued depreciation the purchaser would be in a more advantageous position than he is entitled to be in view of the depreciation which has accrued. Moreover, the result thus obtained when added to the depreciation shown in abandoned property seems to me absolutely unreasonable in the light of my experience with water work structures and in the light of the character of the construction upon this plant.

I have figured on depreciation in using the sinking fund method in two ways; first, applying it to the gross reproduction cost, and second, applying it to the depreciated value of the property and the anticipated remaining life of the structures making up the plant.

This bears primarily of course upon the annual allowance to be made for depreciation hereafter and not upon the accrued depreciation of the property. I have also made computations incidental to

the determination of development expenses based upon the original cost so far as we were able to determine it of the structures, and will give you those figures for comparison. Those figures were based upon the further assumption that there must be amortization through the depreciation allowance to date, not only the estimated accrued depreciation upon the existing structures but also the depreciation which has taken place and which is reflected in the abandoned structures.

I have also considered the depreciation from the point of view of rule of thumb methods, I may say, that is, as a percentage of the gross reproduction cost and as a percentage of the revenue along the line discussed by Mr. Hazen.

In figuring the depreciation I have ignored the salvage value of the structures which might be anticipated at the end of their life merely because I have been in the habit of figuring depreciation in 7970
this way and because with very long-lived structures it has seemed to me rather a refinement which was not warranted by our present knowledge of depreciation requirements. In principle I think it is all right but the difference which results is at best small and is much smaller than the errors of judgment which may arise from the application of any of the theories of depreciation.

Questioned by Master.

You could take account of salvage values in estimated life, but in view of the fact that your estimated life is an approximation, you can well say that you disregard salvage value. Of course, if you consider the salvage value, it tends to decrease the estimated accrued depreciation upon the property. That is not saying, of course, that in the course of a corporation's actual accounting of depreciation there would not enter the salvage element in the account, but in my estimate for the purpose of a particular year, I disregard it.

Questioned by Mr. Searls.

I do not think at the moment of any case where the structures were relaid and used in another place where it would make any difference, because in the case of the structures which have been relaid, or the materials of which have been laid over again, the life which had already elapsed was comparatively short, or at all events, the anticipated remaining life of the structure is comparatively long. I have made no allowance in those cases for the salvage value which may accrue at the end of the actual life of those structures.

Mr. Searls. Q. Where you take into consideration the element of obsolescence, you naturally figure that the structure is going out 7971
of use in a relatively short time in its then present location, that does not mean that it could have considerably greater value in the new location, in view of its practically small depreciation from the standpoint of physical depreciation?

Mr. Metcalf: A. There may be some weight from that point of view if your first premise is right; in other words, that the obsolescence implies that it will go out of service in a short time, and that does not seem to me to be the case in waterworks structures as a whole.

Mr. Metcalf: There is this further consideration, that it sometimes happens that the labor cost of getting the salvage, so to speak, is as great as the salvage of the material. Take, for instance, the pipe in the streets: Often it is cheaper to leave small pipe in the ground, and simply disconnect it, than it is to remove it. That is generally the case in the small pipe lines. If the pipe is 8 or 10 or 12 inches in diameter, it may be advantageous to take it up. It is advantageous if you relay your new pipe in the same trench, but if you do not lay your new pipe in the same trench, the saving in 6-inch pipe, for instance, is very small. It would be much greater here than in the East, because it is shallower—on the other hand, if you had to cut the pavement to do it, I doubt if there would be much return. The pipe is worth more here, and the cost of taking it up is less, and that would have the effect of making the size which you
7972 could afford to take up for the salvage somewhat smaller than in the East.

In my computations I have attempted to make allowance for physical and functional depreciation, and I have suggested that in anticipating future conditions it would be wise to make allowance of a further and small additional sum to take care of contingencies which may arise in view of the danger of earthquake in this region, and also the effect of excessive storms, or other matters of that sort, the inclusion of which in the operating expenses of any year might be a disturbing influence in the operation of the company. The computations were made entirely independent of Mr. Hazen's and along different lines. Upon some of the structures there is considerable variation, but in the main, we have reached about the same results as to fair allowance for accrued depreciation, and for annual depreciation, looking forward to the future. I may say that the annual allowance on the part of all the engineers is not very divergent. It is fairly uniform. The great difference comes in the allowance to be made for accrued depreciation. My allowance of $263,000 is purely a matter of judgment. I have figured it on the basis that allowance should be made in figuring the rating base for the accrued
7972½ depreciation upon the plant; in other words, a deduction should be made of the accrued depreciation.

Mr. Hazen: My theory involves the fixing of the rating base for purposes of investment return upon depreciated value.

(Depreciation, Leonard Metcalf, December 3, 1915, introduced and marked "Plaintiff's Exhibit 160".)

7973 Mr. Metcalf: Depreciation has recently been defined by the Commit-

tee on Valuation of Public Utilities of the American Society of Civil Engineers, in 1916, as follows:

"A general definition is lowering in value or worth, as used in connection with the valuation of public service property, the loss of value due to age and use, including the loss from deterioration, wear and tear, inadequacy, obsolescence, depletion and other similar causes.

"Discussion of depreciation generally includes also causes of loss of value or worth, and methods of depreciation accounting, and of restoring the loss to the property or its owners. Whether all or but a portion of these elements should be considered in valuation depends upon the character of the property, and the method of accounting theretofore used by the corporation. The depreciation due to lowered prices and other non-physical agencies will be called a decrement.

"Depreciation accounting: The branch of accounting by which the wastage, through age and use, of capital invested in physical property, and in some cases in intangible property, is accounted for or offset either wholly or in part. The methods used at the present day are clearly in the developmental stage, and even when prescribed by the same official body are not uniform for different utilities, or even for different parts of the property of a single utility."

The law recognizes that it is equitable that the property of a public service corporation used in the service of the public should be maintained, and the investment kept unimpaired by physical or functional depreciation, that is, by wear and tear, obsolescence, etc., in some manner, through the operating expenses and agency of the rates.

Two general methods of maintaining corporate properties have 7974
come to be generally recognized: First, by the method of replacement; second, by the laying aside of a depreciation allowance or fund, through which, with or without accretion, the property may be maintained.

The replacement method is the one which has generally been used by the railroads and other large corporations having plants involving diversity of construction and variety of units. The replacement method is preferable, where possible, because it is simpler in accounting, avoids the necessity for carrying large funds and tends to enable the governing authorities and the corporations, themselves, to check up frequently the relation between renewals required and funds for renewal being provided through the agency of the rates. The replacement method is applicable particularly to the continuing property with a variety of plant units of comparatively short life, and dependent upon activity of use rather than mere lapse of time. Thus, in the case of the railroad, the rail life depends upon the traffic which it carries, rather than the mere lapse of time the

life of the ties, upon the amount of traffic and time; the life of the cast iron pipes in a water works distribution system, on the other hand, depends rather upon the lapse of time than upon the amount of water carried by it.

The depreciation allowance method of maintaining the property is more applicable in classes of property in which the accumulation of deferred maintenance would be for so long a period of time as to aggregate a disturbingly large amount, or in other words, in which the renewals, when finally realized, would be so large in amount as to embarrass the corporation to meet them in the operating expenses of one or even several years.

7975 Under these circumstances, it is wiser to make provision currently for the depreciation which may accrue suddenly, in large amounts, at long intervals of time, than to attempt to meet the plant renewals or losses when they accrue out of current revenue.

General experience in the operation of water works has shown clearly the wisdom of making provision for depreciation through the agency of an annual depreciation allowance, which may be figured and provided for through the agency of the rates in one of several different methods, rather than through replacement, as in the case of the railroads.

Even in the case of the railroads, which have heretofore taken care of depreciation through renewals, a modification of policy has recently come, under which, and with the approval of the Interstate Commerce Commission, the railroads of the United States, while still taking care of the depreciation of the majority of their plant units or items by the renewal method, are laying aside depreciation funds or reserves to care for the maintenance or amortization of those classes of property, such as railroad terminals, the replacement of which has to be provided for only at long intervals of time, and which would involve so large an amount as to possibly impair the credit of the company, unless the expense involved were spread over a considerable period of years, instead of being met out of the operating revenue of any single year or short period of years.

On the following page are summarized the results which I have obtained by different methods of computation. I think perhaps it would be wiser to postpone a discussion of those until we have gone through the text, showing the basis of computation.

Kinds of depreciation; Depreciation may be classed in a general way under;

7976 1. Physical depreciation, covering the loss in value due to wear and tear of the structures under operating conditions;

2. Functional depreciation, covering loss in value due to obsolescence and abandonments necessitated by changes in the art, in service conditions or demands, etc.;

3. Special contingent depreciation, covering extraordinary renewal, repair or reconstruction costs, such, for instance, as those involved by changes in street grades, the introduction of underground conduits, subways, etc., by injury to structures or consequential damages from broken pipes due to electrolysis, settling trenches caused by the work of other corporations, etc.; injuries and damages growing out of wash-outs caused by cloud-bursts, unprecedented storms or floods, or unusually low temperatures, etc.; and other causes; cost, which, if charged to the annual operating account, might cause such violent fluctuations as to affect the stability of the securities, and hence the credit and borrowing capacity of the corporation, but which, if distributed over a period of years, would be of no serious moment.

That might be called a special contingent depreciation allowance or a contingent reserve allowance, or a general reserve; you may call it by any name that you please, but it is an allowance to cover unusual conditions which do arise from time to time. I have assumed that under regulation, while the governing body might permit the earning and setting aside of such reserve to meet such expenses, when that reserve got to an amount which the regulating body might consider sufficient, it would probably stop further earnings for that purpose. In other words, simply maintain it at a safe point, rather than to continue it indefinitely.

Questioned by Mr. Searls.

I believe that a reserve should be allowed for catastrophies such as the great fire and earthquake of 1906. I think it would be advantageous under those particular circumstances here to carry a reserve 7977
which would take care of such conditions. If you were to limit such a catastrophy to once in a century, I should not consider it desirable to carry a large reserve on that account. On the other hand, I have seen examples of unusual happenings which have resulted in a serious condition for the corporation; that does seem to me desirable from the public point of view, as well as the corporate point of view, to make some such reserve. Unless you do that, there is danger, that the stability of the investment will be, for a time at least, affected, and if it is affected, it simply means that you cannot borrow money for your current needs so advantageously. Obviously, if it very rarely happened, and then in a small amount, it would not be a serious disturbing influence, but it does happen from time to time. For instance, you take on the electric railroads from time to time they have excessively heavy snow storms which result in very burdensome expenses of clearing the snow, and while an average amount may be required from year to year, perhaps once in ten years they have excessive conditions which would prove burdensome. Such a condition happened in Denver while I was there. The matter of war is too remote, I think. I have seen conditions resulting from cloud-

bursts in Colorado which have been repeated, and have happened not once or twice in a century, but much more frequently, and it seems to me it is advantageous to provide for those.

7978 If the contingencies are so remote that they will not affect the company's credit and ability to borrow advantageously, then I would say it is not advantageous to provide for them. That is the distinction which I would draw. I think probably that prior to 1906 the contingency of an earthquake in San Francisco, of the magnitude of the one that happened here, did not have any effect on the borrowing power of any corporation here. At the same time, I think that the company would have been in a stronger position at that time had it had a fund on hand which could have been used for that purpose, or had it had some means in assisting in meeting that emergency. Of course, the other thing which the regulating body could do, is to adopt the policy of amortizing in a successive period of years these excessive losses, and that is what they are doing, as a matter of fact, but I think it is also true that they are allowing the setting aside of reserves.

Questioned by Mr. Greene.

As to the effect of the 1906 catastrophy upon the company, I am familiar with this, that the stockholders were called upon to contribute funds to meet that emergency, and the selling price of the securities was much reduced.

Questioned by Mr. Searls.

7979 I do not wish to convey the idea that if the corporations of Europe had carried a reserve fund in American securities, properly deposited on this side of the water, that they would have been in a stronger position today than they are, but it does seem to me that the investor looks at the credit of a company, and does look to see whether proper allowances are made for depreciation, and whether any reserves are carried; and if the company, as a matter of policy and operation, does make evidently ample allowances for depreciation, it can borrow money closer to the market than if it carries no such reserve, and makes, perhaps, inadequate allowance for depreciation. I think it is reflected in the actual borrowing capacity of the company. The latter class of items might, of course, be covered by a contingent reserve allowance, and so designated, instead of as a special contingent depreciation account, but they have been covered by me in my practice under a separate depreciation allowance as a logical proceeding, and as being the easiest method of accounting them. I am not pointing out any difference between the two accounts, except in name.

7980 Method of determining depreciation. The following methods have all been used as an aid to judgment in determining the fair allowance to be made in figuring the accrued depreciation on an exist-

ing property, and the fair annual allowance to be made for depreciation in anticipation of the future operating conditions.

1.—The sinking fund method.

2.—The straight line method.

3.—Equal annual payment method.

4.—The rule of thumb methods, as follows:

The first based upon a per cent of gross reproduction cost, the second upon a percent of gross annual revenue, and the third on a basis of cents per capita. While the latter cents per capita have no foundation in theory, at all, I have given it to you merely for the purpose of comparison.

None of the methods cited are of universal application, nor are they infallible. All may lead to absurd results unless intelligently applied. Careful inspection of the actual structures, breadth of experience in water works buildings and operation, and thoughtful consideration of the probable future service requirements in the particular structures under review are essential to the formation of sound judgment as to the fair allowance to be made for depreciation.

Classification of structures with reference to depreciation; It will be found helpful, in figuring depreciation, to bear in mind certain characteristic conditions in the life history of water works structures of different kinds, as these have some bearing upon desirable 7981
methods for determining the fair depreciation allowance. Broadly speaking, structures may be classified into;

1. Very long-lived structures of constant high service value, likely to continue in service for a great many years, and in the very nature of things, not likely to suffer physical or functional depreciation. Such, for instance, are well selected and advantageously-located storage reservoirs, dams and masonry conduits of large dimensions. These structures suffer but nominal depreciation, and maintain a very high service value. The annual depreciation allowance should, therefore, be but nominal in amount, and may be determined more or less arbitrarily in the light of the special local circumstances.

2. Long-lived structures of decreasing service value, such as cast iron pipe of large dimensions, which, though having a long period of life, may suffer depreciation through tuberculation and loss in carrying capacity, affecting the service value more or less substantially in a long period of years. For these structures, a larger depreciation allowance must be made. In the determination of this allowance, the sinking-fund method is likely to be most applicable and of greatest aid in the formation of judgment as to the fair annual depreciation allowance.

The loss in carrying-capacity, or in service, may also be of some assistance, but cannot be the sole criterion, inasmuch as in the

original design and construction of the structure, allowance is made advisedly in anticipation of such loss in capacity, and inasmuch as later reinforcement of the pipe system at other points, thus adding safety through duplication or reinforcement, may off-set in some measure the loss in efficiency of service of the structure in question.

And, of course, the pipes may be cleaned, as has been outlined by
7982 Mr. Hazen.

3. Structures of moderate life, concerning the length of which experience has fairly crystallized, and is a safe guide for average conditions. To this class of structures the sinking fund formula applies more rationally. But even here, its application must be subject to the local conditions which may largely modify the future useful life of the structures, as compared with the ordinary life, or experience which would be likely to develop were it not for the special conditions involved.

4. Structures of short life, but yet not so short as to make it desirable that their cost be charged directly into operating expenses. To this class of structures, either the sinking fund or the straight line method may be applied, the difference in result being of small amount.

Custom, so far as it has developed up to this time, in this country, indicates the prevalence of the use of utility commissions and engineers of experience in valuation of the sinking fund formula for water works structures, and of the straight line formula for the short-lived electric, gas and telephone utility structures.

In the determination of the reasonable future allowance for annual depreciation, it is believed that as water works properties grow older and reliable records multiply, experience as to the necessary amount of the annual depreciation allowance in terms of gross reproduction cost of structures of different classes, and in terms of gross revenue of water works properties of different kinds, operating under different conditions, will crystallize to such a point as to admit of the more general application of these approximate but more readily accounted methods of determining the fair depreciation allowance.

In the meantime, record should be kept of the actual experience
7983 of individual water works, with reference to abandoned property, which will make it possible, when coupled with the estimate of accrued depreciation upon existing property, to revise the depreciation allowance from time to time, or period to period, that it may more closely accord with actual experience as it develops.

Assumptions as to probable years of useful life of different structures of the Spring Valley Water Company.

Storage dams: The Pilarcitos and San Andres earthen storage dams have been given nominal depreciation only, corresponding to an assumed useful period of life of approximately 120 years—so far as the earthen embankment involving the major cost of the struc-

tures is concerned—which is reduced to approximately 100 years by reason of certain of the perishable appurtenant structures.

As a matter of fact, the use of any period of time was purely arbitrary; the resulting figures, percent and amount, weighed rather than the period of years, but I have given the equivalent in years, had the sinking fund method been applied, and you will see in the following tabulation the way in which the average figures have been gotten.

The Crystal Springs concrete dam has been similarly treated.

In my opinion the dams will be in use indefinitely; they will not be out of use in 100 years, but that some allowance will have to be made from time to time for upkeep, and there may be, in very long periods of time, by silting up, although I do not think that is a factor. It is merely a matter of prudence, which will take care of any extraordinary thing which may come up, and it is essentially an allowance for the unexpected and even trivial matters, rather than physical depreciation; it seems to me that those storage reservoirs are likely to be used for all time, virtually, so far as we can foresee. 7984
In other words, the depreciation fixed upon this is purely arbitrary.

Questioned by Master.

The possible allowance for earthquake damage, the position of a dam on a fault or something of that sort will have to be taken care of out of this contingent allowance which I have made. The indications thus far are, of course, favorable to the structure; I mean to say, the fault passed through the San Andres dam, but the resulting damage was very small. Some damage was incurred, and would have been covered by this fund.

DIRECT EXAMINATION BY MR. GREENE.

Wooden flumes have been given varying lives, from 23 to 36 years, corresponding to annual rates, varying from 2.7% to 1.25% in accord with the observed condition and age of these structures, and the age and condition at abandonment of the flumes that have been abandoned or replaced, and concerning which information is available.

Mr. Lawrence prepared for me a brief statement of the life history of the past flumes, showing their ages at abandonment, running up 27, 30, 31 and even 33 years, as a result of which I fixed the life period of the existing structures.

Questioned by Mr. Dillman:

Any structures which now exist are provided for; the structures which were originally built and have been abandoned do not appear in the inventory.

DIRECT EXAMINATION BY MR. GREENE.

7985 The matter of age of flumes was purely a matter of judgment, having those figures before me, and going through the flumes and examining their condition, as compared with a mental standard perhaps which I have set up, after seeing the various flumes and getting the records from Mr. Lawrence. It was a matter of their general condition.

The tunnels and other permanent masonry construction have been given depreciation corresponding to an estimated life of 100 years or thereabouts.

There, again, the same remark which I made concerning the dams would apply, generally, that I think the tunnels will remain for all time, but they may require repairs from time to time in long periods, which have not thus far been reflected in the operating expenses of the company; therefore, it seems to me reasonable to make a small allowance for them. The allowance, however, is purely nominal.

The riveted pipe conduits have been built for the most part of wrought iron, and coated with Mr. Schussler's special coating, a mixture of Santa Barbara asphalt and coal tar. This coating has proven to be remarkably effective in preventing tuberculation and corrosion, and is still substantially intact, as disclosed by various examinations made by us, and as observed by the water company's employees whenever repairs have been made of recent years.

The probable life of these conduits, shown in the accompanying tabulation, has been estimated at 72 years, or less, the average life given to all of this pipe being 49 years, accrued depreciation being estimated approximately 20%, varying from a maximum of 55% to a minimum of 4.2%. The average age is estimated at approximately
7986 28 years.

The riveted wrought iron and steel pipe in the distribution system has been given an estimated life of 21 years on the screw pipe, and on the wrought iron pipe of diameters from 12 inches to 44 inches, the average age of the screw pipe being 10 years and of the larger pipe 27 years, the accrued depreciation is estimated upon these two respective classes, at 38% and 16%. This gives the following averages for the combined amount of wrought iron screw pipe and pipe 12 inches to 44 inches in diameter; Life, 37 years; age, 14 years; accrued depreciation, 23.3% ; annual rate, 1.24%, based upon gross reproduction cost plus 0.93% allowance upon the accrued depreciation fund and 2.81% based upon the net or depreciation reproduction cost. That is anticipating the future life.

Questioned by Master.

The 0.93% is explained in this way. If you figure the annual depreciation rate corresponding to the assumed life of any structure, and then figure the accrued depreciation upon that structure to any

year, as, for instance, 20 years out of a life of 40 years, the rate of depreciation which would have to be applied to amortize the depreciated value of that structure in the remaining 20 years of its life may be determined directly from a consideration of the 20 years future period, or it may be obtained by consideration of depreciation corresponding to the total life, 40 years, plus the 4% rate of interest upon the accrued depreciation to date. It is mathematically the same thing. It will be covered in the discussion.

DIRECT EXAMINATION BY MR. GREENE.

The cast iron distributing pipe system has been given an average estimated life of 87 years, the average age being 26 years; the accrued depreciation is estimated at approximately 6%, the annual allowance upon gross reproduction cost of approximately 0.39%, including the precentage of accrued depreciation, and 0.41% upon the net or depreciated reproduction cost. That is based upon the antici- 7987
pated remaining life.

The pumping stations are estimated to have an average life of 30 years, varying from 37 to 10 years, the average age now being 14 years. The average accrued depreciation upon all of the pumping stations is estimated at 30.5%, the annual rate, based upon gross reproduction cost, 1.73%, plus 1.22% upon accrued fund, and upon the net or depreciated reproduction cost 3.60%.

The distributing reservoirs in the city are estimated to have an average life of 73 years, varying from a maximum of 89 to a minimum of 59 years, and an average age of 30 years; the average accrued depreciation upon the six masonry reservoirs is estimated at 14.1%, the annual depreciation rate upon the gross reproduction cost 0.24%, plus 0.56% upon accrued depreciation fund, and upon the net or depreciated reproduction cost 0.88%.

There follow then the tabulations from which these average conditions were determined, showing what was done with each of the structures covered. Thus, for instance, there is first given the summation of the riveted pipe, conduits, chiefly wrought iron, almost wholly of wrought iron, the first being Pilarcitos syphon of 22-inch wrought iron, $33,809; the age in years being 25; the estimated life in years 72; the accrued depreciation upon a 4% sinking fund being 10%; the annual depreciation corresponding to that being ¼ of 1%, or $85 a year. The depreciated reproduction cost then being $30,428.

Now, on the basis of the equal annual payment method, or on the basis looking forward to the amortization of the depreciated value of the structure in the estimated remaining life, which in this case would be the difference between 72 years and 25 years, or 47 years, the rate would be ¾ of 1%, which is $228.

Similar assumptions have been made with regard to the different 7988
pipe lines as there shown, and a summation has been made at the

bottom of the column of the annual depreciation amount, the percentage of which is then found as based upon the gross reproduction cost, and independently the annual amount as based upon the computation of the anticipated remaining life for the new depreciated value of the structures.

Questioned by Mr, Dillman.

Mr. Metcalf: The $85, based on a 72 year life, will result in the same amount as $228 based on a 47 year life, with this further premise that the $85 rate, or ¼%, applies to gross reproduction cost, and the other applies to the depreciated reproduction cost. The $228 wipes out $30,000, and $85 wipes out $33,000; that is the difference, and it is the same thing right through.

Questioned by Master.

The first portion of the table, looking at it vertically, is a pure sinking fund table, and the other is also a sinking fund table; in the other case, it is based upon the anticipated remaining life of the depreciated value of the structures, and in the sinking fund method the rate of investment is rated on value new.

DIRECT EXAMINATION BY MR. GREENE.

In the next tabulation is given a detailed analysis of the cast-iron pipe, from which you will see that I have assumed for the 3-inch and 4-inch pipe a 61 year life, and for the 6-inch pipe 77 years, and
7989 for the larger pipes 100 years life. The table that follows is upon the pumping station. The large depreciation in the Ocean View Pumping Station is made upon the assumption that it will be thrown out of service very shortly. I have assumed there an accrued depreciation of 90%, and a life of 15 years, age 13 years; in other words, that it theoretically went out of commission in 1915.

These reproduction figures are Mr. Hazen's figures, and so far as they are not in accord, they should be modified to that extent. There are some minor differences, perhaps, because one of my partners, Mr. Barnes, worked this up for me in advance of the final completion of Mr. Hazen's figures last year, but it is a matter of a few thousand dollars, and I intended that it should be based upon his reproduction cost figures.

Referring to the ages of some of the existing pumps: One of the Black Point pumps is now 29 years old, two of the Belmont pumps are 27 years old, two of the Merced 24, one of the Black Point 21 years, and one of the Clarendon pumps also, and the remaining two of the pumps are 17 years old, one 15, and three 14 years; they are of a substantial type, and the analysis which I have made of the operating efficiency of the pumps indicated very creditable results, somewhat better than the results being obtained at Los Angeles, perhaps on a strictly comparable basis about the same, when you
7990 take into account the fact that a portion of the water at Los Angeles

is lifted from the ground by pumps that are wasteful, but at all events, the results obtained are in accord with good practice.

The pumps to which I have referred are the fly-wheel pumps, the direct acting pumps being somewhat younger in life. As to the boilers, one of those at the Black Point Station is 29 years old, and still giving good service; one 25 years old; one at Clarendon Station 20 years old; four at Merced Station 25 years old, and so on down the line, the average age of the 24 boilers being 18 years old, and the boilers still being in good service, a very creditable record. Those facts, and the reported condition of the boilers, weigh in the determination of the depreciation which I have allowed.

There follows a tabulation relating to the distribution reservoirs. I have accounted for about $12,000,000 of Mr. Hazen's total reproduction of $25,000,000. The remainder is made up of the main storage reservoirs, some of the longer lived property, and a lot of the miscellaneous property. These particular tabulations are not intended to cover all the property. These were merely grouped together to give the Court an idea of the assumptions I have made with regard to the more important structures. The $12,000,000 is the reproduction cost without figuring overhead or interest during construction. In other words, I have assumed in these structures that 7991
the overhead costs would have to be amortized as well as the structure itself; that when you build a new structure, you will incur new overhead costs. I have depreciated my overhead in exactly the same way as I did the structures, but the figure of $12,000,000 was obtained from these columns, which was based upon the exclusion. These columns have no significance.

As a matter of record, I have given a brief description of the 7992
different methods used and I think it might be well to run through those before going into the details of the computation.

1. Sinking Fund Depreciation Allowance: In the application of this method for determining depreciation there is set aside an annuity or annual percentage of the cost of each structure such that at the end of its useful life the sum of those annual allowances, with the annual accretions earned upon the accumulating sum will equal its cost or its cost less scrap value.

As previously stated I have ignored the scrap value and have predicated my computations upon the cost, here meaning reproduction cost and not original cost because I did not have the original cost of the structures. It would of course be more logical to base our depreciation computation upon actual cost if we could obtain it.

The rate of depreciation may have to be modified by judgment at different times in the life history of the structure to accord with the special conditions encountered, as for instance, when the structure is actively used for a certain period of years and thereafter as a reserve only during the remainder of its useful life.

By the "total life" of the structure is usually meant "the useful years of life" of the structure; by the "age", the years of service seen; by the "rate", the interest rate allowed in figuring the accre-
7993 tions upon the accumulating depreciation fund.

A 4% rate has most often been used heretofore, upon the theory that long term sinking funds could not safely be invested in securities which would yield a greater rate of return than 4% per annum. The tendency today is towards the use of a 5% rate, upon the assumption that the sinking fund will be reinvested in the property of the company itself and that a 5% rate more nearly accords with the cost of money of the company, raised upon its bonds, than is a 4% rate. While the higher rate corresponds with the greater hazard of the business, its use in figuring depreciation allowance is less conservative than is the use of the lower rate since the necessary depreciation annuity becomes the smaller the higher the interest rate and hence amount of the accretions upon the annuities.

The sinking fund may be administered as a bank account or by the actual purchase or calling in by the corporation of its own bonds, paying for them with the depreciation allowance and cutting off the coupons upon the bonds as they mature and crediting to the depreciation account the interest collected upon them.

The sinking fund method may be applied either to gross reproduction cost on the basis of the total assumed useful life of the structures, on the one hand, or to the net or depreciated reproduction cost on the basis of the estimated remaining useful life of the structures.

Detailed computations have been made upon both of these bases for the reasonable accrued depreciation allowance, upon the existing property of the Spring Valley Water Company, and for the fair future annual allowance for depreciation,—the final results being obtained from a detailed consideration of individual structures or groups of structures, the basic computations being attached hereto.

7994 Upon the basis of the gross reproduction cost and the total useful life of the structures of the Spring Valley Water Company, with an estimated 4% sinking fund rate and gross reproduction cost of \$25,129,000, the fair allowance for the accrued depreciation upon the existing property as of December 31, 1913, is estimated at 13.9%, or \$3,496,000. The fair annual depreciation allowance is estimated at 0.57% (\$142,000), plus 4% of the estimated accrued depreciation \$135,000 equals 0.54%, making the total fair annual depreciation allowance 1.11%, \$277,000. This corresponds to a total estimated life of 53 years.

As applied to the net or depreciated reproduction cost on the basis of the estimated remaining useful life of the structures as of December 31, 1913, with 4% sinking fund rate, the fair annual depreciation allowance is estimated to be 1.18% of the depreciated reproduction cost, or \$256,000 per annum. This is equivalent to an

estimated remaining life of approximately 38 years. Note, however, that the difference (15 years) between the total life of 53 years estimated above and the remaining life here estimated at 38 years, does not represent the age of the property which is estimated at 25.8 years, for the reason that in the second case the percentage is based upon the depreciated reproduction cost, the first, upon the gross reproduction cost, and that some variation is caused by the assumption that certain of the structures will have a prolonged passive life, as reserve structures, to which fact consideration was not and could not readily be given in the first computation, based upon gross reproduction cost. Had it not been for that the results would have been identical.

Questioned by Mr. Greene. 7995

To explain the two percentages to get 1.11: In the first case I figured the depreciation allowance on each structure which would correspond to the total life of those structures and got as a result a certain percentage, 0.57% per annum which would correspond to an allowance of $142,000 per year; that presupposes the existence theoretically of a fund amounting to $3,496,000 today; now, under the application of the sinking fund method if it is to be assumed that but 0.57 shall be allowed each year as a depreciation allowance upon existing structures the fund must be left intact until the structures have been amortized; you would then allow with that depreciation allowance of $142,000 rates based upon the entire value of the property.

If, on the other hand, you predicate your assumption that the rates must be based upon the depreciated value of the property then you must earn in addition to your sinking fund allowance of 0.57 a return upon the fund which has accrued today, namely, $3,496,000.

Allowing the 4% upon that fund adds an additional amount of $135,000 and gives you the total sum. The same result is obtained by the other method which I have discussed of taking the depreciated value of the property, that is, the difference between $25,000,000 in round numbers and $3,496,000 depreciation and assuming that the remaining value of the structures must be amortized in the remaining life of the property. Under that assumption, as is here shown, I get a result of 1.18%.

The fact here that in the one case I get 1.11% and in the other case I get 1.18% grows out of the assumption in the case of certain structures, as for instance, I think the Millbrae pumps is a case in point—at all events there are certain structures which have been actively used for a certain period of years and which I assumed would be used in the remaining life of those structures as reserves or 7996
less actively; in other words, that they would last longer under the conditions of service to which they will be put in the future than they would have lasted under the conditions of service under which

they have operated in the past, so that the life would actually be lengthened,—

On the other hand, it would not be fair to say in figuring the accrued depreciation by the first method that the life had been lengthened by that amount because the depreciation which had already been suffered could not be determined from the average conditions but had been more rapid in the first part of the period, that is, the elapsed life than it would be during the latter part of the period, when the structures served merely as reservoirs.

Questioned by Mr. Searls.

I took the facts; the elapsed life is a fact, and the 26 years represents the weighted average of the agreed ages in the schedule as nearly as we could determine it. That was not based on my inspection and observation. The primary basis for it was found in the rate at which the pipe system had been laid, with allowance for certain of the other major structures which had been built. It was not possible to take every structure and find the weighted average; the computation would have been frightfully laborious. What I did was to multiply the actual age agreed on in the inventory by the gross reproduction cost of that structure, and then divide by the
7997 total of all the structures.

Questioned by Master.

I did compute a depreciation increment for all the items in the inventory. These averages have no significance, except to give you a bird's eye view of the whole.

(Metcalf's Depreciation Analysis, on the basis of 4% sinking fund, based on reproduction cost, introduced and marked "Plaintiff's Exhibit 161").

(Metcalf, depreciation detail, computation by Straight Line Method, introduced and marked "Plaintiff's Exhibit 162").

Exhibit 161 is the Straight Sinking Fund computation, except that I have added in the last column the figures based upon the depreciated reproduction cost, looking forward to future life. This covers the detail computations from which I drew off my summarized sheet. I went through it in the same order in which it appears in the inventory. I wanted to check up what I had done by assembling properties of different kinds together. I do not know of any other
7998 way of applying the sinking fund method; it is an awfully laborious thing. I don't see that there is a mathematical formula based on the straight line method any more than there is on the sinking fund. Of course, I have given you the average conditions as found by summing up all of the individual computations, as you will find on page 2 of Exhibit 160. There, for instance, is shown the total annual allowance, as I figure it, which, divided by the gross reproduction cost gives me the result in percentage which I have stated. Then I took up through my sinking fund tables the life corresponding to that per-

centage. That is the way in which I got the 53 years. That is based on an average weighted according to these individual amounts. The effect upon that of changes in different amounts, I could not tell you. I should have to go through the computations to see what effect it would have.

Questioned by Mr. Searls.

I have used 4% as a matter of habit, I think; I was more familiar with that. I might have used the 5% basis. Had I done so, it would have reduced the annual allowance to be made, and would also have reduced substantially the accrued depreciation upon the existing structures. I have no idea of what the difference would be in annual allowance. I do not think it would be a large one in the annual allowance; you cannot take it by direct ratio.

Questioned by Mr. Greene. 7999

I think that all the structures appear in my exhibit here with the depreciation which I have allowed on them, so that they can be fitted in to the schedule that Mr. Hazen filed. They have been grouped together in some cases, as for instance, a conduit line has been shown as a whole, and not separated into various items; the auxiliary structures on the line, however, are shown independently. I think there is reference in this to show the page of the inventory at which a given item would apply. I think it is covered by the binding.

Questioned by Mr. Dillman.

Referring to page 8 of Exhibit 160; I add 4% of the estimated accrued depreciation to the $142,000 for this reason: I assumed that we should deduct from the gross reproduction cost the accrued depreciation today, and rate it on the depreciated value of the property. If you want a rate on that basis, you have to make this other allowance; in other words, if you assume only the $142,000 allowance per 8000
year for depreciation, you would have to figure your rates on the gross reproduction cost, and not the depreciated value, because it is based on the assumption that this fund is kept intact until the amortization of each structure, must be kept intact in order that the annual increment may come into the fund itself.

I do not mean that this $3,000,000 on which the 4% is computed is kept in the hands of the company without drawing interest; if the company has in hand a fund of say, $4,000,000, and the value of the property is $25,000,000, then the company should earn but $142,000 a year, and the rate should be predicated upon the depreciated value of the property, or $25,000,000, less the $3,500,000, or whatever the figure is. This $3,500,000 is accrued depreciation.

Look at it from the point of view of future conditions; if today the value of the property is that of the depreciated property, let us say $25,000,000 less $3,500,000, it is certainly equitable that the company should be permitted to amortize that sum in the remaining an- 8001
ticipated life of the plant. The connection between the two is this:

either you must be permitted to earn the 4% accretion upon this assumed fund, or you must have the fund in hand, so that the fund itself may earn that amount. If you have the fund in hand, then, of course, your rate should be based upon the depreciated amount. If you had not the fund in hand, you must either be permited to earn \$142,000 plus \$135,000, in which case the rate would be predicated upon the depreciated value of the property, or your rate must be predicated upon the full value of \$25,000,000, and you would then be permitted to earn but \$142,000 for depreciation.

Questioned by Mr. Searls.

If you figure the reproduction cost of the structures, you would be doing the city an injustice if you then figured the depreciation on the basis of original cost, if the original cost was less than the repro-
8002 duction cost, because you would get a smaller amount than \$3,500,000 as the accrued depreciation which should be deducted from the reproduction cost, but you would get a slightly smaller amount for annual depreciation allowance. In other words, I think that as long as the annual allowance for depreciation and accrued depreciation of the property are interdependent, it does not make much difference what basis you use for figuring it. Of course, theoretically, your depreciation should be figured to amortize the amount of money, in other words, the cost of the structures, if you are dealing with cost; if you are dealing with reproduction cost, I think you then ought to use, in figuring your depreciation, the reproduction cost figures. I suppose you could, if you knew the original cost of the structures, give the company justice if you figured your depreciation allowance on the original cost, and then expanded the accrued depreciation on the basis of the ratio that the reproduction cost bore to the original cost. Your accrued depreciation would be larger in proportion, but it would be because the structures had increased in value, and consequently the percentage to the new reproduction value remain the same, although the gross amount of accrued depreciation would be larger, but the difficulty with that, according to my theory, is in finding the original cost of the structures. I have no means of doing that.

8003 There is the further difficulty that you would be applying a different unit price schedule on similar structures, perhaps, because of the change in prices from year to year. If, however, you were measuring value from the point of view of cost, I think you should also make your depreciation analysis on the basis of the original cost of the structures, if you can do it. That is what I have attempted to do in the computation of development expense, and the allowance for depreciation based upon original cost. I have applied my percentage to the original cost figures as we had them as a matter of experiment, trying to find out if what I gave in the first place might be about right, carrying the computation through, and finding at the end of the computation that I had not just the right amount in my accrued de-

preciation fund to take care of the accrued depreciation upon the existing structures and the abandoned structures, and having to cut it down and increase it, and recompute it, until I found a percentage finally which approximately covered the total sum, or the combined amounts of the accrued depreciation in the shape of abandoned property, and upon existing property.

Mr. Dillman: We do not agree at all. If I see this thing at all right, the 4% is entirely wrong in that allowance. If equity has been done, \$3,400,000 has been paid for accrued depreciation, and is in the hands of the company, and if it earns anything in the hands of the company, the company is not entitled to take an additional 4% of that amount out of the hands of the rate-paying public.

Mr. Metcalf: You are quite right in that; in other words, if your 8004
rate has been sufficient to give a fair rate of return, and to take care of depreciation throughout that period of time, so that they may fairly be assumed to have laid aside such a fund, and it has been laid aside, I think your remark is right, but that is not the condition here prevailing.

Mr. Dillman: Then the 4% can only be added on the ground that equity has not been done in the past, and it is to make up for that lack of equity.

Mr. Metcalf: From one point of view, that is true. That presupposes, however, that you have operated during those past years with knowledge that depreciation is to be accounted, and that you have in addition to that depreciation allowance been permitted to earn a fair rate of return.

Questioned by Master.

Mr. Metcalf: I assume that in fact in the past the returns have not been sufficient to provide for the accrued depreciation, and I propose to present that later. I do not amortize that accrued depreciation in the remaining life; I am giving them the credit for the depreciation which has accrued.

2. Straight Line Depreciation Allowance: Under the applica- 8005
tion of this method the cost, or the cost less scrap value, of the structure is assumed to be amortized in equal-annual-payments without accretion upon the accumulating sums, the renewal being made directly from the depreciation fund, and any interest earned upon it being accounted as a source of revenue. Thus, if a strucure has an estimated life of 50 years, the depreciation allowance becomes 2% per annum; if 10 years, 10% per annum.

As stated previously, in making this computation which appears in Plaintiff's Exhibit 162, by the straight-line method, I have not made any allowance for the scrap value of the structures.

Mr. Dockweiler: I do not do that either.

Questioned by Master.

Mr. Metcalf: I can dispose of that in my estimate of the life

just as well; you never know whether your age is going to be 40 years or 42 years, anyway; the whole thing is too speculative, I think.

DIRECT EXAMINATION BY MR. GREENE.

The method has application particularly in the case of short-lived structures, and because it may be readily accounted. It is open to the practical and theoretical objection that it is not in general accord with actual experience in the life history of structures other than those of very short life,—the result of the application of the former giving considerable higher allowance for accrued depreciation in the early years of life history of the plant than is justified by the usual actual condition of the structures,—structures generally suffering small depreciation and maintaining high service-value dur-
8006 ing the earlier years of their life history and depreciating more rapidly during the latter years.

In accordance with the written request of the Master, however, computation has been made here showing the effect of the application of the straight-line method of determining the depreciation of the structures of the Spring Valley Water Company, upon the same assumption as to age and length of useful life of the structures which were made in figuring the depreciation by the sinking-fund method.

The result indicates a total accrued depreciation upon the existing structures as of December 31, 1913, amounting to 31.2% or $7,835,847; and an annual depreciation allowance of 1.6% of gross reproduction cost, or $404,000. The latter percentage corresponds to a period of life of approximately 62.5 years.

It is to be noted that this straight-line depreciation computation was based upon the estimated gross reproduction cost of the structures. There are shown below, however, the results of the application of the straight-line method to the original cost figures as found in the development expense or going concern analysis.

The essential difference between these two methods is not limited simply to the question of relative costs for labor and materials under past or historic, as compared with present, conditions, but is also very substantially influenced by the fact that in making the computation upon original cost, consideration must be given to the abandoned property.

In other words, the total accrued depreciation allowance figured must, up to the date under consideration, cover not only the accrued depreciation upon the existing structures, but also the past accrued depreciation in abandoned property, unless the original cost be limited to the original cost of the existing structures. The importance of this
8007 fact will be realized when it is stated that in the case of the Spring Valley Water Company it is estimated that up to December 31, 1913, the accrued depreciation upon the existing property based upon the sinking fund method amounted to approximately $3,500,000, and the

accrued depreciation in the form of abandoned property to a substantially equal amount.

The excessive amount of the result obtained from figuring the depreciation of the structures of the Spring Valley Water Co. by the straight line method—which gives an accrued depreciation of 31.2% upon the existing structures, and 39.6% upon the original property, (including in the latter the abandoned structures), upon structures of an average age, slightly less than 26 years—will appear a little later in the consideration of the practical limits within which depreciation has been found to lie in waterworks practice.

The 39.6% accrued depreciation in a period of 25.8 years would amount to an average of 1.53% annually, whereas experience has shown that the actual rates, including abandoned property, generally lie between 1% and 1¼%, approaching the smaller rate in plants having more substantially built, long-lived structures, and the larger rate in those having less well built and relatively short-lived structures.

In general, for a property of this age, the accrued depreciation upon the existing property is likely to lie between say 12% and 15%, slightly exceeding the latter amount perhaps, in the case of properties containing many short-lived structures. The results of the application of the straight line formula, on the other hand, yields, as stated above, 31.2%; the sinking fund method, 13.9%.

Depreciation based upon original cost determined in development 8008
expense analysis: Referring to the analysis of development expense, based upon past and historic conditions, and original costs, and based further upon the assumption that the accrued depreciation allowance, as of December 31, 1913, must cover the abandoned structures as well as the structures never in use, and the depreciation upon the existing structures in accord with the brief tabulation on page 11. The following results were found:

(a) Upon straight line depreciation allowance, an accrued depreciation amounting to $6,774,000, as of December 31, 1913; the annual depreciation rate was found to be 1.25%, and for that year, $266,000.

(b) Upon a 5% sinking fund basis, an accrued depreciation amounting, up to December 31, 1913, to the total sum of $6,886,000; the annual depreciation rate was found to be 0.50%, and amounted to $427,051.

(c) Upon an equal annual payment basis, an accrued depreciation which amounted, as of December 31, 1913, to $6,886,000; the annual depreciation rate was found to be 1.6%, and the amount $228,-000. Note that in each case, under the hypothesis the accrued depreciation should have amounted to $6,769,000, but as these detailed computations are exceedingly laborious, and their results are in the 8009
final analysis at best, only of aid in forming judgment, it was not thought of enough importance to carry the computations to a finer

degree of accuracy to warrant the expense involved. With the existing doubt upon correct hypothesis, precision cannot be hoped for.

3. Equal-Annual-Payment method of determining the fair annual depreciation allowance is based upon the desire to so adjust the annual depreciation allowance, that it, together with the amount of the fair return upon the depreciated value of the property will remain constant from year to year, provided no additional expenditure of capital be incurred. In as much as the annual deduction of the depreciation from the original costs of the structures results in a constantly decreasing value, the fair amount of the annual return, which is based upon it, also decreases. Therefore, if the sum of this fair return, and the depreciation allowance is to remain a constant one from year to year, so that the rate-payer shall pay the same amount from year to year for the same service, the annual depreciation allowance must, under the application of this method, constantly increase during the life history of the structure. Practically it is found that this rate of increase is equal to, and may be determined by, the addition of the annuity figured on the sinking fund basis increased by the accretion upon the fund accumulated to date. That is that 4% that we discussed before.

Questioned by Master.

In other words, that 4% is the amount which capitalized at 4%
8010 represents the decrease in value of the capital for that year. The decrease in the capital being the accrued depreciation; the two being equal. It might be added that under that method what you in effect do is to regard the depreciation fund as an amortization on the capital, and then per contra, all renewals as reinvestments of capital.

DIRECT EXAMINATION BY MR. GREENE.

The method, as applied to original costs here, results in an annual rate of depreciation of 1.60%, and annual depreciation allowance of $228,000 as of the year ending December 31, 1913. The method is not believed to have an application in the case at bar, in as much as the method has not been applied heretofore in the conduct of these works, and as the depreciation allowance has not been treated as an amortization of capital, nor have the renewals been treated as new capital expenditures—as becomes necessary under the operation of the equal-annual-payment method.

4. Rule of thumb methods, based upon actual experience.

(a) Percentage of gross reproduction cost;
(b) Percentage of gross annual revenue;
(c) Cents per capita.

In view of the fact that waterworks construction was not generally or actively undertaken in this country until the seventies, it is clear that experience with many waterworks structures has not pro-

gressed sufficiently far to give a clear indication of their ultimate life, or period of useful service. Moreover, new machinery and devices are constantly being introduced in the waterworks field, which have been under trial for comparatively but a few years. It is clear, therefore, that the past record of even the earliest waterworks in this country, furnished by a partial record of the magnitude of the fair allowance to be made for depreciation, as determined by the abandoned structures, and that in figuring the actual accrued depreciation upon any 8011
waterworks property, judgment must be based upon the depreciation in the existing property, as well as in the abandoned property. Mr. Hazen and I, for many years now, have been endeavoring to find reliable data in the actual experience of different waterworks properties as a guide to reasonable depreciation allowances. The attempt has been made to collect records from specific waterworks of the total accrued depreciation, first, in the shape of abandoned property, and second, in depreciation upon existing property. The problem has proven an exceedingly difficult one, owing to the incomplete character of the records of almost all corporations of this kind. Up to the present time, fairly complete rocords have been obtained concerning the actual depreciation in abandoned property, and upon existing property in the five following cases:

Portland, Maine, Water District; Racine, Wis., Water Co.; The Denver Union Water Co.; Pennsylvania Water Co.; and the Spring Valley Water Co., and I might say that the Pennsylvania Water Co. supplies Wilkinsburg and a chain of towns adjacent to it, stretching as far as Pittsburg, and covering two wards of that city. A statement with regard to these several plants, and a summarized statement of records follows:

The next page is Portland, Maine, and this simply shows the records as I have them, with a brief statement with regard to the character of the property, and the sources of information. In some cases it has been necessary to estimate the gross revenue during the early years of operation, for while we had some evidence along that line, the records were not complete. To the extent that there are errors in 8012
the assumption with regard to the depreciation upon the existing property, there will be error in the final result, although not in like amount, because the record of the abandoned properties in general covers something approaching one-half of the total depreciation; therefore, if a certain error is made in the estimation of the depreciation in the existing property, the error on the whole property would not be over one-half of that percentage.

On page 32 is given, in comparative form, the same data submitted by Mr. Hazen, arranged perhaps a little differently, or by the addition at all events, of the depreciation allowance as based upon the gross reproduction cost, as well as that based upon the net reproduction cost. Thus, about the middle of the table, you will see the head-

ing "Average Annual Straight Line Depreciation in Percent", based upon (a) gross reproduction cost and abandoned structures, that is including the depreciation upon the existing, and upon the abandoned structures. On the next line, under "(b)" is shown the amount of this depreciation expressed in percent, based upon the net or depreciated reproduction cost.

In the case of the Portland Water District, as based upon the gross reproduction cost, it amounts to 1.29%, as based upon the depreciated reproduction cost, 1.46%. Racine has 0.45%, and 0.47%; Denver Union Water Co. has 1.16%, and 1.31%; Pennsylvania Water Co., 1.29%, and 1.39%; the Spring Valley Water Co., 0.93%, and 1.06%. The average of the five being 1.02%, and 1.13%; of the four with which I am personally familiar, 1.17%, and 1.30%. Similarly on the basis of the gross revenue during the whole operating period, the percentages are as follows: 9.57% for the Portland Water District; 6.7% for Racine; 12.4% for the Denver Union Water Co., where the rates were less adequate, and hence, the percentages greater; 8% for the Pennsylvania Water Co.; and 8.45% for the Spring Val-
8013 ley Water Co. An average of 9.02%, and upon the four plants with which I am personally familiar, 9.6%.

I reckon my income as also including the impounded moneys. It would, of course, be a greater percentage if it were reckoned on the moneys, exclusive of those that have been impounded. Under "(d)" is shown the per capita amount which, theoretically, is without basis, but which it is interesting to note amounts, in the case of the Portland Water District to 45 cents per capita, Racine 15 cents, Denver Union Water Co. 57 cents, Pennsylvania Water Co. 48 cents, and Spring Valley Water Co. 59 cents. Those are per annum per capita.

Questioned by Mr. Searls.

I do not draw any particular conclusions from these figures. It is merely a unit that may be of assistance in checking estimates that I shall make hereafter. I shall make the estimates on the bases stated, and check them by the estimated percent of gross revenue, and also per capita. Subsequent experience may prove that there is nothing in this, but it is a rough guide; it cannot be a close one, because, obviously, the depreciation allowance will depend upon the character of the construction, and not the number of persons in the community; it might be true if all communities were alike, and the structures depended only upon the size of the community and the water consumption, and not upon the annual reserves and difficulties of construction. I think a per consumer basis might be a little more enlightening, but the difference would be very slight; it would not affect it in the cents place; I think it would be mills. Where you have a community that is
8014 served by more than one company, it would tend to throw my calculations out in application to other communities. I do not know that

it would throw them out entirely, but it would certainly make them less reliable.

Questioned by Master.

The difference in my figures, which has been accomplished by the changes made in Mr. Hazen's valuation, by agreement of the parties, is very slight. The approximate difference in the accrued depreciation allowance, resulting from substituting for Mr. Hazen's figures the joint exhibit figures, amounts to a decrease of about $55,000. My present figure of $3,496,000 would be decreased by the sum of $55,000; that is in the accrued depreciation.

Mr. Hazen: I think about approximately $280,000 on the cost of reproduction less depreciation is approximately correct for the difference in present value.

This total figure of mine here includes all the paving over mains.

DIRECT EXAMINATION BY MR. GREENE. 8016

Mr. Metcalf: On page "C", the third page of Exhibit 160, is given in condensed form a summary of the depreciation analysis which I made, showing in parallel columns the final results. First, we have the reproduction cost basis, the computations on 4% sinking fund, based upon gross reproduction cost of $25,126,000. The resulting accrued depreciation, 13.9%, and in amount $3,496,000; the annual depreciation allowance, 1.11%, or $277,000, made up of the two sums heretofore discussed. The second method relates to the determination of the fair annual depreciation allowance, determined from a consideration of amortizing the depreciated value of the structures within the estimated remaining period of life of these structures, and there I find the annual allowance to be 1.18%, or $256,000. The third method is the straight line method based upon gross reproduction cost, and the same assumptions as to the length of life, which were made in figuring the depreciation upon the sinking fund basis, resulting in an accrued depreciation estimate of 31.2% as against 13.9% for the reproduction cost basis, an amount of $7,836,000, comparable with the $3,496,000 of the sinking fund computation, an annual rate of 1.6%, or $404,000.

Mr. Searls: It might be interesting to note at this point that our witnesses only figure on accrued depreciation of about 23%, I think, as compared with your 31 on a straight line basis.

Mr. Metcalf: That is true; that only shows how conservative my assumptions were on the sinking fund method as to the length of life of structures, as I view it. Of course, it means that I have assumed a shorter life for the structure than they have, on the whole. My proportion is 31%, which could only be obtained if I had assumed a 8017 shorter life of the structure than Mr. Dillman has. The longer the life you assume, the less the annual contribution is.

Mr. Searls: I looked it up last night, and roughly it is about

23% for our side, so that, taking the straight line, on our assumption, it would be fairer from your point of view, than the assumptions that you have made.

Mr. Metcalf: It would, as judged by other yard sticks.

DIRECT EXAMINATION BY MR. GREENE.

Mr. Metcalf: Under the second class, I have the discussion of depreciation from the point of view of original cost, on a 5% sinking fund basis, a total cost of $21,306,000, including the overhead cost and interest, except for a six months period. The reason for that assumption, with regard to the interest, under the development expense computation, grows out of the fact that I have taken care of the interest after the six months period in the assumed fair rate of return upon the investment of the previous year. Upon that basis I get an accrued depreciation which is designed to cover the $3,500,000 ac-
8017½ crued depreciation upon existing plant, and approximately $3,500,000 upon the abandoned property; at the time that the computations were made, our abandoned property list amounted to approximately $3,273,000. As the result of further study those figures became $3,506,000; in other words, we found that certain structures had been overlooked. Upon that basis of the original cost, amounting to the sum stated, the necessary annual depreciation rate was found to be one-half of 1%, and the amount corresponding to that as of the year 1913 would be $427,000; on the straight line basis on cost, excluding overhead, it was found to be 1¼%, which, as of the year 1913, would amount to $266,000.

8018 Under the equal annual payment method on cost, excluding overhead, the allowance was 1.60%, or $228,000 per annum. I then repeat the comparison of the data upon actual experience discussed by Mr. Hazen, and finally under No. 8 show you that my assumed fair depreciation allowance, for the annual allowance, $260,000 a year, to cover physical and functional depreciation, amounts to 7¾% of gross annual revenue, including the 15% at issue in this proceeding, and 57 cents per capita, and that the allowance of $320,000 a year, which would include a reserve, or contingent allowance of $60,000, would amount to 9½% of gross annual revenue, and 71 cents per capita.

The development expense computation has been made along the lines indicated by the Wisconsin Railroad Commission, based upon the original costs of the structures. It has been assumed that the corporation was entitled to earn, first, the operating expenses, second, the repairs and maintenance account, third, a fair depreciation
8019 allowance, and fourth, a fair rate of return upon the capital sum. The capital sum is determined in this way: At the end of construction the capital sum is the investment cost of the property. At the end of the first year of operation there is added to the capital sum

the operating costs and repair accounts, and taxes, and the depreciation allowance, and the fair rate of return upon the investment cost upon the completion of the property, and there is deducted from that sum so found the actual revenue earned during that first year. In effect there is added to the investment cost upon the completion of the property any deficiency in revenue earned during the first year, or if an excess is earned, it is deducted from the capital sum. On the following year the same course of procedure is followed. In making the computation of the proper depreciation allowance, the sum of the allowance made in the period of years from the inception of the plant until December 31, 1913, must equal the abandoned property, and the estimated accrued depreciation upon the existing property; that, then, gives you a measure of the percentage, and to find that is a very laborious process, but that has been done here.

That is represented in that column, and is upon the three theories, one the sinking fund theory, in which case this depreciation fund is assumed to have interest added to it each year, the other the straight line method, in which there is no such accretion of interest, and the third one, the equal annual payment method in which this amount is deducted each year, that is, the depreciation allowance is deducted each year from the capital sum.

Questioned by Mr. Dillman.

To explain in detail my third item, the straight line on gross reproduction cost, by which I get an accrued depreciation of \$7,000,-000, and an annual depreciation of \$404,000: You will see on page 8020
1 of Plaintiff's Exhibit 162, the first item, "Pilarcitos Dam", the reproduction cost \$319,702, which is exactly the same item that you find on page 1 of Plaintiff's Exhibit 161, based upon the sinking fund method; the date of construction was 1867; the estimated life was 123 years, although that was arbitrary, as I told you, but it corresponds to a life of 123 years in that particular item. That corresponds to 8/10ths of 1% per annum, which upon the sum of \$319,702, would be \$2,599; the age is 46 years, and 46 one hundred and twenty-thirds is 37% of the total amount, \$319,702, which is \$119,600. The difference between \$319,702, and \$119,600, gives you the net reproduction cost, or the reproduction cost less accrued depreciation, amounting to \$200,102.

You will see exactly the same figure for the sinking fund method on page 1 of Plaintiff's Exhibit 161. The corresponding annual depreciation allowance, instead of .8%, becomes .05 of 1%, and the annual amount instead of \$2,599, becomes \$160. The accrued depreciation on age of 46 years becomes 5%, as against 37% upon the straight line method, and in amount, \$15,985, as against \$119,600, leaving a net reproduction cost of \$303,717, as against \$200,000. This probably is one of the most extreme cases we could have picked out, on account of the very long life of the structure, but you will see

that the two are in parallel columns, so that you can compare the two exhibits page by page. Also, at the foot of each one of these in-
8021 dividual sheets you will find a summation, and separately stated, the engineering, contingencies, and interest-during-construction items, and the same percentages are applied to those as were found for the structures without those items added to them, so that I have in effect applied the same rates of depreciation to the overhead and interest-during-construction items as to the unit costs, or reproduction costs of the structures without overhead and interest during construction. At the end there will be found a table summarizing those results.

Questioned by Mr. Searls.

I also have this summary page in my Exhibit 160. The difference between the amount of accrued depreciation, when figured upon the reproduction cost, as compared with the amount of accrued depreciation, when figured on the original cost, is this: When you are dealing with reproduction cost, you must remember that the inventory as prepared, excluded all of the abandoned property. When you are dealing with original costs, you include all the abandoned property. The difference is due to the abandoned property, which amounts to about \$3,500,000. That abandoned property is not included in the \$7,000,000 which I show in the straight line basis of reproduction cost.

The reproduction cost basis, using the sinking fund method, amounts to about \$3,500,000 accrued depreciation, while on the straight line basis I get about \$7,500,000; when I come to the original cost basis, I get approximately the same sum on accrued depreciation
8022 on whatever method I use. I start with the hypothesis that I must have the same sum.

Based upon the original cost, I must cover the accrued depreciation upon the existing plant as well as upon the abandoned plant, and I assume in effect this: That the accrued depreciation upon the original cost figures would be substantially the same as to the existing property that it would be under reproduction cost. In other words, I assume the same probable lives.

Mr. Searls: I am noting the wide discrepancy between the accrued depreciation under the straight line method as compared with the other methods on a reproduction cost basis, but when you come to consider the practical agreement between all three methods under original cost basis—in other words, you have \$7,000,000 to \$3,000,000 in the reproduction cost basis, and you have got approximately the same sum all along in the original cost basis.

Mr. Metcalf: I think an error has been made in the table; it had not occurred to me before. I think it grows out of this fact, that in making the computation we have started with the assumption that
8023 the combined amount of the abandoned properties, and accrued de-

preciation as of 1913, should be about \$6,770,000; under the straight line assumption that would not be the case, because they pay off quicker at the beginning.

I think we shall have to make that computation over again on the other assumption. The computation should then be made on the basis of making the straight line total amount equal to \$7,800,000 plus \$3,500,000. That is \$11,200,000, to be strictly comparable with the figures as found here, the \$7,800,000. What we were after, of course, on the original cost basis, was to see the effect upon the rate of depreciation resulting from the assumption of different methods of applying this rate. That is, whether by the sinking fund or straight line, or equal annual payment, upon the assumption that the same amount of depreciation allowance must be realized in that period of years in each case in order to make them strictly comparable.

If my original cost assumptions were logical, after I had computed my accrued depreciation on those assumptions down to date, it ought to, relatively at least, check the accrued depreciation under the original cost theory. I think I can make it clear to you why we 8024
got this result. Assuming that it is true, as a matter of fact, that the accrued depreciation upon this property, including abandoned structures, as well as depreciation upon existing structures, amounts to about \$6,770,000, what I wanted to know was, what would be the corresponding annual rate of depreciation, as based upon the original cost figures. Now, that is what I gave you in this computation. Your question is predicated upon the assumption that I start with a combined amount of accrued depreciation, as of 1913, of three and a half million in abandoned structures, and \$7,836,000 in accrued depreciation on existing structures, and under those circumstances I would so modify my straight line percentage, which was found to be 1¼%, as to yield in that period of time, up to 1913, not \$6,774,000, but \$11,-300,000, the latter being the sum of \$7,836,000, plus \$3,500,000.

Questioned by Master.

I used the figures of \$3,496,000, plus \$3,506,000, in getting my figure \$7,800,000, with this further correction, that when I started the computations last year, instead of being \$3,506,000 for abandoned structures, it was \$3,273,000, and that added to that \$3,496,000 gave me \$6,774,000. You were right that in figuring line 5 you should take the sum of line 3, plus the accretion for abandoned property, as 8025
representing accrued depreciation to date.

The original cost estimates do not cover original structures; it is impossible to make the same sort of analysis based upon original cost that I have made upon reproduction cost figures; it could not be done, because we have not the individual structures, and therefore, the only basis upon which I could make my comparison as a check upon reproduction cost figures was to see how the annual per-

centage as applied to the whole investment of the year would work out. I could do two things; I could either assume the annual rate, or I could assume the sum which I wished to realize in depreciation, and in as much as I was checking a computation which I had made of the accrued depreciation, I based my computations on the assumption that I must realize that sum, and this attempt was to find what resulting annual rate I would get when thus applied. If I had had the individual figures for each of the structures, I could then have assumed the length of life for those structures, which we have assumed, and made the computation of them. The same disparity would be shown under the original cost basis as is shown under the
8026 straight line figure for accrued depreciation and any sinking fund figure, if we could make the comparison on the same basis, but I have not the data to do that, and I could not do it.

Mr. Searls: The thing that struck me first was that knowing for instance that Mr. Dockweiler, with a depreciation allowance of approximately 1.78%, with a total accrued depreciation of 23%, gets a figure of $5,000,000, it would seem that you ought to come a little closer to getting the percentages here if the straight line were properly applied.

Mr. Metcalf: I think you will probably find that the variation was due to the difference in life assumed on certain other structures. Of course, the differences are in the right direction, because Mr. Dockweiler has started with a smaller gross reproduction cost, and a higher rate than I have, and he gets a smaller total amount. That smaller total amount is due, in the first place, to the fact that his unit figure, that is the gross reproduction cost estimate, is lower than mine, and in the second place, to the fact that there is variation in the assumed length of life of the structures.

Questioned by Mr. Dillman.

The $85 per annum for 25 years, at 4%, amounts to either 41.6 or 43.3, depending upon whether you put it in at the beginning or the end of the year.

ONE HUNDRED AND TENTH HEARING. MARCH 6, 1916.

Witnesses: Leonard Metcalf for Plaintiff.
J. H. Dockweiler for Defendants.
Geo. L. Dillman for Defendants.
Allen Hazen for Plaintiff.

Witness: Leonard Metcalf for Plaintiff.

8027 Questioned by Master.

Mr. Metcalf: Referring to Exhibit 160, page 9; I have first gross reproduction cost, and then I have two columns on the straight sinking

fund method, giving my total annual payment into depreciation fund, and my total accrued depreciation, based on the gross reproduction cost. Then in column 7 I have the net reproduction cost on that method, being the difference between column 2 and column 6. Then I have my depreciation allowance in the same, column 9 corresponding to column 4 on the so-called equal annual payment method, where I base my return of investment on the depreciated reproduction cost 8028
and the anticipated remaining life.

Column 10 is this: You remember I referred to the fact that in some cases the two methods did not give exactly the same result, for the reason that I had assumed that some of the structures might have a remaining life as a reserve, a sort of a passive existence, in which the rate of depreciation would be less per annum than it had been in the past; under those circumstances, the rate which you would get in anticipating the future could not be reflected in the past conditions; that is, determining the rate on the sinking fund method and the gross reproduction cost. If it had not been for that disturbing influence, column 10, to which you referred, would be identical with column 9 throughout. I have given to you some idea of the variation of the items in which the greatest variation existed, merely as a check on the other computations. If the assumptions had been identical throughout, then column 9 and column 10 would have been identical. The final column shows the result that the total of column 9 bears with relation to the total of column 10, in other words, the ratio of column 9 to column 10. Take for instance the example of a pump, 75% of the value of which might be assumed to have suffered depreciation, leaving a residual value of 25%; then assuming that the remaining life of the remaining quarter of the structure is longer than the original assumption made under the sinking fund method, I would still figure the depreciation according to the life history, according to the active life of the pump, as otherwise I should get less than ¾ deprecia- 8029
tion on that structure had I taken the entire life, combining the original assumption and the anticipated remaining life of this machine; so that you can prove it one way or the other, and I have segregated it this way to give you an idea of the variations.

Questioned by Mr. Searls.

I did not make any attempt to get an approximation of the original cost of the structures, including abandoned structures, as a basis for checking the figures that I got on reproduction cost. I did try to see if we could find the original cost, and could separate the structures to compare the original costs and the reproduction cost of the structures, but I found that the records were so incomplete that I gave up the attempt. We know the total investment, and we could approximate the total cost of the lands and the water rights, but the segregation as between structures you could not possibly tell. We found entries in the books covering certain structures in general, but

you could not tell from year to year how much work had been done on the individual structures, and we found it impossible to make such a segregation. If you took some of these weighted averages which I applied to the whole, and apply them to the gross figures, which you might obtain by striking the land and water rights cost from the total investment, it might shed some light on it, but it seems pretty unsatisfactory; at all events, we have not done that.

Dockweiler Witness: J. H. Dockweiler for Defendants.

8030 DIRECT EXAMINATION BY MR. SEARLS.

8031 The table preceding the first page of the memorandum which you have, sets forth the estimated lives which I have used, and it is taken from my appraisal. I have given to the Crystal Springs concrete dam unlimited life.

The table referred to is as follows:

8032 TABLE OF PROBABLE LIVES USED BY J. H. DOCKWEILER IN COMPUTING ACCRUED AND ANNUAL DEPRECIATION

Structures	Estimated Life
Concrete dams	Unlimited
San Andres and Pilarcitos Reservoirs (except embankments)	100 years
City reservoirs	100 "
Cast iron pipe	100 "
Sunol Filter Galleries	90–100 "
Tunnels	100 "
Riveted Wrought Iron Pipe	60 "
Same in Pumping Stations	45 "
Pumping Engines	50 "
Boilers	25 "
Other Pumping Station Equipment	30 "
Weighted Averaged Pumping Stations	42– 45 "
Lake Merced Structures	40 "
Flumes	19- 35 "
Standard Screw Pipe	40 "
Buildings	25 -50 "
Total Structures	
Weighted Average Probable Life	71 years
Weighted Expired Life	19 "
Weighted Remaining Life	52 "
Percentage condition	73.5%
Accrued Depreciation	26.5%
Annual Depreciation Allowance Straight Line	$268,736.00 or 1.42%

8033 The Crystal Springs Dam I consider will be used as long as water is being supplied to the City of San Francisco. I cannot conceive of any system of supplying water to this city that will not for all time

utilize the Crystal Springs Dam, the San Andres Dam, and the Pilarcitos Dam, in the Peninsula system. Crystal Springs Dam undoubtedly will, and should be raised to create a larger reservoir capacity. Experience has demonstrated the success of the method of constructing the Crystal Springs concrete dam. At the time when it was first built, it was somewhat of an experiment as to whether such a structure would give the best result, since the mixing and placing of concrete was not so well understood at that time. While the dam has a larger section for its present use than modern practice would suggest, nevertheless, in view of the fact that at the time when it was built there was great opposition to the construction of any dam on San Mateo Creek above that town, it is, in my opinion, one of—well, I would call it the keystone of the whole impounding system of the Spring Valley Water Co. Taking into consideration that it can be, and will be raised, full value should be given to it for all time. I think it is getting better as it grows older. Some criticism has been made in the past about the size of the dam. At the time when Mr. Schussler designed the dam in 1886, I certainly, speaking for myself only, would not have felt that I would have been justified in building it on any smaller lines than it has been constructed upon. An engineer, weighted with the responsibility of a water system, is not justified in taking a chance—by "chance" I mean skimping—when the utilizing of a little more money gives him security; so that I cannot bring myself to any position that will criticise the size of this dam, and the amount of material it contains.

Mr. Searls: We shall not claim a deduction for the large size 8034
of the dam.

Mr. Dockweiler: The San Andres and Pilarcitos Dams I consider have the same degree of permanency as the Crystal Springs concrete dam. They have been tried; they are better now than when first built. They have been thoroughly shaken up by earthquakes, and the fact that there was a spill in the San Andres proves two things: One, that the slope of an earthen dam should not be made any steeper than the slopes of these dams, and second, that the relation of the puddle to the balance of the structure was well proportioned, and that the puddle, as the earthquake found, was not too wet or sloppy, because I can readily see that the shaking of a dam by means of an earthquake, if there is a sort of viscous mass in the center, would have a tendency to cause the dam to settle and squash out at the bottom, so that I think the action of these dams proves the fact that your puddle must not be sloppy. It must be moist and damp, but it cannot be sloppy, or else any shaking is going to cause it to flatten right out, and your dam will fail through that action.

I have assigned unlimited life to the embankment, and 100 years for the auxiliaries in all the dams. I have assumed that conditions 100 years hence, or at an earlier date, through the requirements of

8035 larger quantities of water, the placing of different forms, using different forms of conduits, a larger size of conduits between San Francisco and these reservoirs, may necessitate the alteration, or practically the construction of parallel or auxiliary structures, which would, in a way, terminate the value of usefulness of these structures which are now serving as auxiliaries. By auxiliaries I intend to cover, for instance, gates, wasteways and tunnels.

The Upper Crystal Springs I consider as serving in a dual capacity, as a roadway embankment, and as a device for a settlement basin—for the creation of a settlement basin—and I have allowed the value of embankment to the main structure, and have given value to the auxiliary structures, such as the culvert, the tunnel, the gate-house, etc., because it does serve some value as a settlement basin. There is this to be noted, however, that when the water gets up to the level of
8036 the concrete wasteway, that it then flows into the lower basin, and it separates the water only up to the height of the bottom of the concrete wasteway, and when the water overtops that, it flows into the lower basin. I have made an allowance of $1,096 per annum for depreciation on this, which is to cover the gate-house and the auxiliary structures; no depreciation whatever has been estimated for the embankment. I consider that has indefinite life. There always will be a roadway at that place. I consider the physical life of these structures, both concrete and earthen embankment, as practically permanent; I cannot conceive of any physical deterioration. Also, there will be no functional depreciation whatever.

I have estimated the life of all cast-iron pipe at 100 years. This estimate has been based on judgment, partly, and partly upon the personal examination of the pipes in the yards, and in the trenches, during a period of 12 years, and also I have been informed by estimates which have been used by various authorities. On the cast-iron pipes in the city, especially in the sandy sections, there seems to be a sort of an iron coating which has a reddish yellowish appearance when the pipe is uncovered, which forms on the outside of the pipe, and it seems to protect it some way or another. I consider that the cast-iron pipes in the City of San Francisco have not only the possibility, but the probability of the longest life of cast-iron pipes of any city that I know of; in other words, the vast majority of this pipe lies in trenches
8037 that are not alternately wet and dry, but are what we call a dry trench, and I think that makes for the long life of the pipe. Many authorities give the life of cast-iron pipe as 66 2/3 years; in fact, that has been the life estimated. I think Mr. Schussler even gives it 66 2/3 years, and also some of the Spring Valley engineers. I cannot see where less than 100 years can be assigned to it. I have seen pipes that are 50 years old taken up on Market Street and some of the side streets, and their condition goes to justify me in my contention that 100 years is not too short a life period. I have seen pipes that have

been taken up as the result of a joint investigation on behalf of the company and the city, and apart from being tuberculated, or damaged, due to life or to wear, if you might so term it, that was much less than anyone could have reasonably anticipated, in view of what the literature on cast-iron pipes would lead them to expect.

Judge Farrington estimated 100 years life; Foster's Engineering Valuation, pages 204 to 207, quotes the United States Government allowance for depreciation, cast-iron mains from 75 to 100 years. The Wisconsin Railroad Commission, in the Appleton Waterworks case, decided May 14, 1910, volume 5 of the reports, on page 215, estimates the cast-iron distribution pipe at 100 years of life. These authorities, with the exception of Judge Farrington's opinion, have no direct bearing on the Spring Valley pipe, but merely go to show the general estimates of life on cast-iron pipes in other localities; I have taken it right straight through that 100 years is the least life, in my opinion, that can justly be ascribed to these pipes.

Filter Galleries: These are concrete structures, and physically 8038
they have a permanent or an indefinite life. From the Water Temple down stream towards the Sunol Diversion Dam, these galleries practically serve as aqueducts, or carriers of water, and while there are in the stretch, sections in which these small pipes are placed, and thus let the water into the gallery, these structures I consider more permanent than that part of the gallery which serves purely as a collecting gallery from the Water Temple up stream. I have given these galleries a life of from 90 to 100 years. There is this to be noted, that the Calaveras water, as soon as the dam is built to its ultimate height, will practically all be impounded in the reservoir. Hence, a great source of supply, which in the past has fed these galleries, will be cut off. Now, it is a fact that the waters of the Calaveras River have been bodily diverted into the trench which leads up stream from the Water Temple, and in the bottom of which trench a filter gallery is placed, so that it would go to show that the material lying between this trench or this gallery and the Calaveras stream, does not lend itself to permitting sufficient water from the Calaveras to enter this gallery on the Calaveras side. Before the pipe line was built from Pleasanton to the Water Temple, the waters developed by the Pleasanton wells were turned into Laguna Creek, and allowed to flow in that creek to a short distance above Sunol, at which point they were reclaimed from Laguna Creek by means of the Hadsell Ditch, and conducted by means of this ditch to the head of the gallery which runs up stream from the Water Temple. That ditch has been done away with, and the waters diverted directly from the Pleasanton wells by means of the Pleasanton pipe line, into the Water Temple.

Questioned by Mr. Greene.

The galleries below the Water Temple will always be used as a 8039
carrier for water from Pleasanton, and it is more probable that the

others will be given up, as against that part which runs from the Water Temple down, because if it did not filter a single drop, it would be used as a carrier, as the continuation of the pipe line from Pleasanton to the Sunol Dam or aqueduct. I don't think there would be any great advantage in having the water from San Antonio Creek coming in. You would probably run your water down direct from a larger pipe, because ultimately, if the waters are to be filtered, it looks to me as if a large filter plant would be built at some place near to the City of San Francisco. I have not worked out any definite arrangement in my own mind; it is a pretty complicated arrangement.

8040 Questioned by Master.

The Calaveras water will have a line running direct into the City of San Francisco, or else into something delivering that water by gravity, and using the benefit of part of the elevation, and it may be delivered into the San Andres Reservoir.

Mr. Hazen: The Calaveras waters will not go through these filter galleries as far as the diverting line from the dam is concerned, but that line would have less capacity than the Calaveras Creek; in other words, the Calaveras water would fill the pipe line contemplated in that way, and there would still be quite a large surplus which could be let down to Sunol, for instance, in dry times, and make these Sunol Galleries work 365 days out of the year, instead of during the wet part of the season, as at the present time; there is also a large area tributary to Sunol, which is not tributary to Calaveras.

8041 Questioned by Mr. Greene.

Mr. Dockweiler: My idea, with regard to the San Antonio Dam, is this; you would have an outlet, and you would pipe that water from San Antonio down to the Sunol Aqueduct. When the San Antonio Reservoir is constructed, then I would pipe my water direct down to the Sunol Aqueduct; the Sunol Aqueduct is not more than a couple of feet in elevation, and the water level of the Calaveras Reservoir would be about 780 feet, so it seems improbable that the water would be dropped to that elevation, and then be re-pumped into the City of San Francisco; so, in my contemplation I do not see that any of the water of Calaveras ultimately will ever be dropped down. Some of the surplus may be to reinforce, but if you are going to develop the San Antonio and the Arroyo Valle, and what you can get from your Pleasanton development, I do not see—I am frank to tell you I have not made that study of the economy of handling those waters; it is a big problem.

DIRECT EXAMINATION BY MR. SEARLS.

Tunnels: I have given those in the main 100 years of life, and I think they would average that. In allowing 100 years, I have given
8042 consideration to a possibility of obsolescence due to a necessity of larger pipes for a change.

Riveted wrought-iron pipe: This estimate is also based upon personal examination of such of the riveted pipe as I have been able to inspect at various points, and in the company's yards, during the past 12 years. While the life which I have estimated is perhaps 10 years in excess of that ordinarily given by the authorities, in my opinion, the Spring Valley wrought-iron pipe is entitled to this extra allowance, due to the care exercised in laying and placing it, and to the superior character of the dip which Mr. Schussler used. None of the dip was knocked off, as far as I could see. I examined the Pilarcitos pipe line after the earthquake, and I chipped off some of the dip, and I found the blue mill scale of the plate underneath the coating, showing that where the coating was undisturbed, that at that point the metal was as good as the day it came from the mills. It goes to prove that that dip is a remarkable one. I do not think there is anything like it anywhere. I should certainly try to utilize that dip wherever I could specify it in laying a pipe, because dip is the thing that preserves the life of a metal. I have the formula for the mixture, and I have also seen the pipes actually dipped. I have noted the care with which the pipe was treated in dipping it, and it further goes to sustain 8043
the reasonableness of the prices which I stipulated with Mr. Hazen as to the cost of dipping. The Spring Valley dip has thickness to it, and there is life in the compound. I have taken some of that dip that is 30 years of age, and broken it, and it has all of the constituent elements of the asphalt remaining, and I think asphalt is one of the most permanent of cementing materials.

Pumping stations: I find a weighted average of from 42 to 45 years as the probable life of the stations, although I have taken the pumping engines at 50 years, the boilers at 25 years, and other pumping station equipment at 30 years. I note that Mr. Metcalf gives a useful life limit of from 30 to 50 years on pumping machinery, high duty, in large units, in his article in the New England Waterworks 8044
Association Journal, as compared with 20 to 30 years for ordinary pumping machinery. With the exception of Ocean View and Precita Valley, which I have estimated at 25 and 20 years, respectively, I am of the opinion that the remaining Spring Valley pumping stations deserve classification with the best of long life limit.

I have observed these pumping plants for the past 12 years, and listened to criticisms of them, and this fact always confronts you, that the stations have performed their duty; there has been no breakdown; while the pumps have been built heavily, the extra metal which has gone into them has not cost much, and has fully justified the design of the man who created them. I instance this point to sustain my contention for long life. The Millbrae Pumping Station originally comprised two units, one of which was moved away, and incorporated into the Central Pump now located at Lake Merced on Sloat Boulevard. The diameter of the cylinder of the remaining

pump was increased, and the same pump, by the simple expedient of boring it out, which was possible through the extra metal contained in the cylinder, has an added capacity, so that if you divide the price of that pump by its original capacity, and divide it by its present capacity, you have a comparatively cheap pump per unit of capacity. The security that you will get with a few extra dollars in the case of a water supply, I think is justified. What I mean to say
8045 is that these pumps were well constructed, and they cost good money, but the expenditure was justified. Lots of times you spend money, and you do not get results. Here you have gotten results.

Lake Merced structures: I have given some account for possible life through obsolescence; in other words, the Lake Merced structures are peculiarly circumstanced; as a source of supply the lake itself should be maintained, if for nothing else than a storage basin. It is handy, and I do not think it would be policy to do away with it altogether; it is conceivable of such a situation—through earthquakes and war—that all sources of water supply could be cut off from the Peninsula. Lake Merced is close by, and it has that value; it is pretty hard to measure it in dollars and cents, but an engineer viewing the situation would say, you have to give me an awful good excuse if you are going to do away with this basin. Here you have $2\frac{1}{2}$ billions of water, and it looks to me as if that lake would have,
8046 for all time, a potential value as a basin. Ultimately we may find that it would pay to have an array of machinery, the first cost of which is very little, and the operative cost is very high, but it will be the economical arrangement, because you do not expect to use such pumps very often, and when you do it will cost you considerable to operate them, as against more expensively designed and constructed machinery; but the fixed charges which this cheap plant will represent won't be eating its head off.

I have given a 40-year life to Lake Merced structures, and in estimating that 40 years, I did not figure that there would be an additional loss of life there through obsolescence; that obsolescence may take place, but if it does take place, I have not considered it in that 40 years, but there are structures there that have filled up. Large quantities of sand have washed in, and not only has the basin which the dam created been filled up, but the top of the dam has been covered; in other words, you have got to dig down into the floor of the ravine to find the top of your dam, and hence, the dam going out has carried with it some of the conduits; a rearrangement of a great many of the works there will undoubtedly take place, so that as to some of the remaining structures, they have gone out to the action of the elements in moving the sand there. Whether or not this loss through depreciation and obsolescence will take place,
8047 I am not prepared to say at the present time. There has been a great deal of contention advanced by the company in past years that Lake

Merced would always be necessary for a safety reserve, by reason of its being the only portion of the water system not separated from the city by one or more earthquake faults. I have not given that question of earthquake faults so much study, but I find the lake there within the city limits, and in my opinion, a natural basin like that cannot be ignored.

Questioned by Mr. Greene.

Whether it is kept in use by the company, or not, it is a potential factor there, and I think would justify an installation of the cheapest kind of machinery, so that if all of your plants are cut off, you can get water there. My view point is that it is likely to be continuously in service, either actually, or in reserve. 8048

DIRECT EXAMINATION BY MR. SEARLS.

Flumes: In view of the excellent character of the construction of the Spring Valley flumes, and the careful attention that has been given to their maintenance, it would seem that a maximum life of 35 years is not unreasonable, although in the case of certain structures I have varied it considerably in accordance with my judgment. Judge Farrington, in his opinion in the 1903-04 case, allowed $2\frac{1}{2}\%$ as the annual allowance for flumes and wooden structures, which would correspond to a 40-year life. From the best information I can get from the company's records, I think 35 years is the maximum life of them. They are built of the best of material, and they are built in such a way that they make for the longest life possible. I examined all of those flumes foot by foot. I walked over them all, and I stepped down and examined them underneath as well. They are constantly kept full of water; there are flash-boards there which dam up the water. They are so fixed that you can pull them out very quickly. They are carefully blocked up, and there is ventilation under them. The main structures don't come in touch with the soil at all, and if one block rots out, you can put in a fresh block.

I have given the standard screw pipe 40 years. This is 10 years less than the age assigned to similar pipe by the Wisconsin Railroad Commission in the Appleton Waterworks Case. I think that 40 years in a sandy soil, such as most of that pipe is laid in, is fully justified. 8049

Buildings: My depreciation figures indicate a wide range of estimates on the probable life of wooden buildings. My figures are from 25 to 50 years. It would be impossible to assign a reason for the estimates made in each case, but in general I took into consideration the character, the location of the structure, the use to which it has been put and is being put, the degree of care and maintenance which has been given it in the past, and what its probable utility or life will be. I examined each of these buildings before I made the appraisal and estimate. I think there are two or three out-buildings

at Pleasanton that I did not get at, but the best you can say for some of them, is that by courtesy you give them the title of buildings. The regular structures of the company, used in the operation, are all well maintained. The company keeps the system up. The late policy of the company, I think, gives them an added value in making them presentable. In other words, putting in nice fences, and giving the posts coats of paint, and making it pleasing in appearance, and giving the public access to the grounds. Upkeep does tend to in-
8050 crease the probable life of the structures. It is absolutely essential.

Weighted averages: These averages were computed for me by Mr. Ellis, and were obtained by dividing the total reproduction cost new of the structures as shown in my appraisal, by the total annual depreciation allowance, obtaining as a weighted-average-probable-life for all structures, 71 years. The weighted-average-accrued-depreciation of 26.5% was obtained by dividing the total accrued depreciation by the total reproduction value new. This gives a percentage condition of 73.5%. My average actual age was obtained by multiplying 71 years, being the average probable life, by the 26.5% of accrued depreciation. This gives an average expired life of 19 years, or an expectant life of 52 years. These figures are subject to the weakness that they include structures out of use, and will have to be modified by agreements between the parties as to certain structures, but taken as a whole, they give a fair general indication of my calculations on depreciation. They do not include any reference to concrete dams and structures, which I have given unlimited life to, but those structures figure in the reproduction cost new. They are zero, no depreciation, but they figure in reproduction cost new, and if you exclude them, of course, the ratio is affected.

8051 Mr. Hazen: I would simply like to enter an objection to the conclusion that the average age can be computed in this way. I do not think I understand this process clearly enough to point out all the defects, but as I understand it, the age is a reciprocal function of depreciation. Perhaps this is not exactly what was done, but it is equivalent to this, finding the reciprocal of certain numbers, and averaging those, and then taking the reciprocal of the averages as representing the averages of the first numbers. As a mathematical proposition, that does not work out that way, and that method will not lead to true results. That is not a matter of speculation on my part, I have tried it with figures many times, and I know that figures reached in that way cannot be taken as an average of the direct figures.

Mr. Dillman: If the depreciation is figured strictly on a straight line basis, the average gotten, as Mr. Dockweiler has it, would be the average gotten in the way Mr. Hazen has gotten it—the weighted average.

(It was suggested here, by Mr. Hazen, that they try it on a

specific case, and see if it does come out as Mr. Dillman states. This was done as follows:)

Mr. Hazen: I will do it Mr. Searls' way; that is, without taking a structure having indefinite life, and will then add my first item at the end. Call the first $100. There will be 50 years of age, 100 years life. The value is $50 and the depreciation is 50. Taking another $100 item, 15 years old, with a 20-year life; the depreciation will be $75, with $25 left. Take another item $100, 2 years old, 40 years life. That will have $5 depreciation, and $95 left. Adding those up, we have $300, and the average age will be 22 1/3 years; the depreciation is $130, which is 43.3%, and 56.7% condition. The annual depreciation for the first item will be $2, the second item will be $5, and the third item will be $2.50, so the total annual depreciation will be $9.50. Then we divide the $300 by $9.50, and it gives us an average life of 31.6 years. We multiply 31.6 years by 56.7% condition, and we get 18 years as the average life, whereas the direct comparison gave 22 1/3 years. 8053 8054

DIRECT EXAMINATION BY MR. SEARLS. 8055

Mr. Dockweiler: If I were going to use the sinking fund theory for figuring depreciation in this case, I think I would use 5% as my percentage of interest. If it is going to be put in a bank, and not used, I don't see where you can get over 4%; if it has gone in the works, I would say 5%, but you are all going to get back to the reliable straight line theory when you come to your funds, because no interest rate is straight line. The straight line method is the only way I can get at it, because you are ultimately going to get back to the straight line method. What assumptions can a man make as to the rate of interest on any fund of a long life structure of 100 years; it is beyond me.

Witness: GEO. L. DILLMAN for Defendants. Dillman

DIRECT EXAMINATION BY MR. SEARLS.

Depreciation is a fact, but its amount is not fixed nor definite. There is physical depreciation—wearing out, or rusting, or rotting out. There is a diminishing capacity to reservoirs by silting, and to pipes by diminishing capacity. There is a functional depreciation by supercession, such as applies to the Upper Crystal Springs Dam, and the Davis Tunnel. There are changes in the art which make more up-to-date structures desirable. A few years ago there was a voiced public sentiment against water from Lake Merced which might have compelled its abandonment, and the relegation to scrap and second-hand material of those pumps and other structures for its use. 8057

This depreciation is estimated in my exhibit. It is sometimes estimated from inspection, but generally it is computed from an assumed life, by what is called the straight line method.

There are many methods of computing depreciation, all having their advocates, and all having some claim to being right, but, as the facts of depreciation are only approximation, refinements in computation seem out of place. The straight line method is the simplest, with the exception of the replacement method, with the probability of its being as near the truth at any one time as any other method. So the general principle—"Whatever simplifies serves", and "Whatever complicates is bad", warrants its adoption.

Nor is there much practicable difference in application to either the rate-paying public or the water company. They average the thing as structures are being renewed and replaced at irregular intervals. While other methods will get higher or lower depreciation rates, some will be higher while others are lower, so the average will be fairly well maintained.

The other methods considered are the Replacement Method, the Sinking Fund Method, and the Equal-Annual-Payments Method.

The Replacement Method is not as crude as would seem at first
8058 glance, inequity would result if a large percentage of parts would reach the end of their useful life at one time, but in practice these times are so scattered that his method might closely approximate any other method.

The Sinking Fund Method is logical, but the result depends upon the verity of assumption as to probable life, and also the rate of return on the fund. The computation is not simple; it has to be explained frequently. The additional assumption and lack of simplicity in computation are reasons for its rejection.

The Equal-Annual-Payments Method is reached by the Sinking Fund computations, with a view to avoiding the charge that depreciated value is the proper value to consider. It is only a subterfuge, and reaches identical results with the Sinking Fund Method. Here is a chart which I have made, with a view to illustrating these different methods of working the sinking fund.

(This chart was introduced and marked as "Defendants' Exhibit 163".)

The upper lefthand corner of the chart is the starting point; value 100% of the cost, structure new. That is a definite point. The lower righthand corner of the chart is a less definite point, but in these computations is assumed as being a definite point, with no scrap value; if the scrap value is 10% or 20% of the original value, then the lower righthand point would be raised 1 or 2 inches, as the case might be. However, this refinement is ignored, and I think properly so, as the recovery value is not large in the case of most of this property.

Any part of a plant follows some line from the upper lefthand corner to the lower righthand corner of this chart. The space above the line followed at any time is the depreciation; the space below is the value of the plant; that is, the cost new less depreciation. If the replacement method is followed, the upper line of the chart is followed from the upper lefthand corner to the upper righthand corner, and then at the end of the life is depreciated its whole amount, 100%, to the point at the lower righthand corner. If the straight line method is followed, the diagonal straight line shown on the chart is the line followed. Between these two points any number of curves can be drawn which may approximate the truth, but each curve will depend upon the assumption of life—and so does the straight line as to that, but it will also vary with the rate of interest. I have drawn two of these curves, showing the result of a 10-year life assumption, with 4% interest, and a 50-year life assumption with 7% interest. I have marked a line below the straight line path which illustrates ordinary automobile depreciation, in which I have assumed that the machine depreciates 50% of its first cost every year thereafter, which is not very far from a correct assumption in my experience. 8059

The advantage of the sinking fund, or equal-annual-payment method, is that the rate-payers pay an equal annual amount into the depreciation fund. That is the principal argument. Any other curve 8060
between those two points might be followed. It might be assumed that the depreciation was the reverse of this automobile depreciation, which would result in a conic parabola; it might be assumed that the depreciation took place the other way, as a cube of the remaining life, and in that case you would get a conic parabola. You might assume any other number of curves there with equal propriety as assuming the sinking fund curves.

If you are going to apply a method in approximately the middle of the life of a plant, the same objection as has been offered to the straight line method would hold if the same curve was followed. By beginning in the middle of the life of a plant, and applying one method—inspection for the accrued depreciation—and then a carefully computed depreciation for the future, it would result in a 8061
broken-backed curve, which might be very inequitable and incorrect in result.

I have taken the first two items in Mr. Metcalf's Exhibit 160, page 5, and shown the 2 curves which he uses for those two items. In the first case the curve is slightly broken-backed, but not seriously in error; in the next case the error is very much the other way; in other words, the first payments are very much greater than they would be by the straight line method. To explain what this means: This chart is the same as the other chart, except that this is expressed in years. These two items have a 72-year life; Mr. Metcalf's as-

sumption runs to here, 25 years, and if carried on would go beyond the 72-year life. His second assumption goes to 15 years; that would run the life out inside of 15 years, but he still sticks to his 72-year assumption.

8062 Questioned by Mr. Greene.

I have reached an answer to the suggestion Mr. Hazen made this morning with regard to Mr. Dockweiler's computation; as an abstract proposition, Mr. Hazen's statement is correct, that the age gotten from a division of the total depreciation by the annual allowance is not the average age of the part. But the averages of the parts has nothing to do with the thing, and instead of Mr. Dockweiler and myself calling that quotient the average age of the parts, it should be stated that that time is the time when the annual allowance will wipe out the first cost, which, in this particular problem, is considerably less than the average age; it is possible that it may be more in other cases, but in this particular case it is about two-thirds.

Mr. Dockweiler: The computation itself is correct. I do not claim that that has merit, other than showing that result by the computation made by us.

Questioned by Mr. Hazen.

Mr. Dillman: The figure as to the average life of the structures is not the average age of the structures; it is less in this case, and I think it is less in every case that I can think of—I think it is in the
8063 problem at hand. For instance, Dockweiler gets 19 years, and I get 20 years by the same method; it should not be called the average age of the structures, but it should be called that time when the annual allowance would wipe out the principal, or that part of the principal that has accrued depreciation to date. I am talking about the 19 years now; in other words, it is that period of time which, multiplied by the annual allowance, would equal the accrued depreciation.

Mr. Dockweiler: In other words, had $268,000 been paid for 19 years, it would measure the accrued depreciation up to date, and that is all that can be said.

Mr. Dillman: The average age, I think, is considerably more than that, and I think it is in every case, as far as that is concerned.

Mr. Searls: The effect of that is simply to show that the accrued depreciation, as measured by our method, is somewhat greater than the actual age of the structure shown, but it does not mean that injustice has been done the company if the straight line method be consistently followed.

Mr. Metcalf: I want to think it over, but I think you are right, assuming the propriety of using the straight line method, and the accuracy of its application.

8064 I was trying to distinguish between what you might get by computation, and what has actually taken place in fact; in other words, it being my belief that under the use of the straight line method you

get an apparent accrued depreciation to date, which was, in fact, greater than the actual depreciation which had taken place, and that in the use of the sinking fund method it more nearly approached the fact in waterworks practice. Of course it is accentuated on account of the point in the life of a structure at which we approach this problem, but I believe the results which you get from the application of the sinking fund method are more in accord with the facts as to the actual rate of depreciation than the straight line method. In other words, I mean that the sinking fund method measures the matured depreciation more accurately than the straight line method. by the term "matured" I include just what Mr. Dockweiler did; in 8065
other words, functional as well as physical depreciation.

(The statement of Mr. Dockweiler was read here, as it was thought that Mr. Metcalf had misunderstood the statement.)

Mr. Metcalf: I was talking about the depreciation in the existing property, regardless of the abandoned property, and as to that I believe that the results obtained by the sinking fund method are more nearly in accord with the life history of the plant, that is, the depreciation which takes place from year to year, than by the straight line method; in other words, I believe that the straight line method, as to long-life structures, marks too large a depreciation in the earlier life history of the plant.

On the same condition of facts, depreciation must vary as the interest rates vary; in other words, when you were getting no interest on your impounded fund, if we may so term it, then you have got the straight line, and the less the rate of interest, the nearer you are to the straight line. Of course, the effect of the application of the sinking fund would vary with different rates; the lower the rate which would obtain, the higher would be the annual amount which you would get by the application of that principle. In effect it is a straight line depreciation allowance with no interest working.

Assuming the same age of the structures; that is, the actual age,
and assuming the same life which you have assumed for the 4% rate, 8066
you would get a smaller accrued depreciation on the use of a 5% rate than you would on the use of a 4% rate.

I am saying that since depreciation, ordinarily, in a waterworks plant is progressive, and not equal each year, it follows a curve, and that the sinking fund method gives that curve. It makes no differ-
ence whether the depreciation to be earned should approximate the 8067
depreciation in fact as it comes along, if it is a matter of contractual obligation, and it is understood between the parties at issue what method shall be used; but when we come to discuss the matter from the point of view of past conditions, when there has been no such understanding, I understand that we should aim to find the actual depreciation, as distinguished from the accounting depreciation, as closely as we can. So far as paying for the depreciation is concerned,

it can be paid for by any correct method of cost accounting, whether straight line or curve line; whether it be treated as a problem in maintenance as the railroads treat it, it makes no difference.

8068 Questioned by Mr. Searls.

Mr. Metcalf: If you assume that reproduction cost is substantially greater than the original cost, then if you figure your depreciation on the basis of original cost, and apply your percentages to those original costs, you will get too low an accrued depreciation, and in this case it would not be fair to the City; if, on the other hand, the reproduction cost is less, it would not be fair to the company.

8069 (Counsel for Defendants here stated his understanding as to what constituted a confiscation of value, and that the courts have not anywhere held that you are required to give back the present day value, or increase your depreciation allowance every year so as to make up for the continuing increment of value, but that you must return to the investor the money originally put in the plant, and allow him constantly an interest return on the value of his plant to date.)

8069-8072 (Mr. Metcalf called attention to an error in the table, as shown on page 5 of his Exhibit 161, covering Stone Dam Syphon, \$70,000, which should be \$20,800. He advised that it was carried into the table so that the footing should be \$4,035,410, instead of \$4,085,410. On the recapitulation line of that page 5, foot of the column, accrued depreciation in percent should be 19.3%, instead of 20.2%. In the line underneath that the 4% on accrued depreciation, \$826,600, should be \$776,600. The next column of annual percentage becomes 0.69, and the figure underneath it 0.77, instead of 0.81, making a total of 1.46 instead of 1.49, and the \$33,000 in the next column becomes \$31,000.)

Questioned by Master.

Mr. Dillman: To explain as to how I can plot a 10-year life and 50-year life on the same chart: You see the circles and abscissae are entirely in percentages, so that it is a universal chart, but in this chart I have made one element years, instead of percentage of life, so the chart is intended to be a universal chart, as illustrating depreciation methods. I did not plot any of these parabolic or cycloidal curves in there that I mentioned, but it is obvious that any trail can be followed from the upper lefthand corner to the lower righthand corner; I think I show a little later on that it is a matter of no importance.

I have estimated large dams as having a life of 200 years. I have no reason to believe that they will become useless in 200 years, but it seems something of a hazard that any construction subject to any sort of deterioration, functional or physical, can be considered to have a life of over 200 years. The depreciation amounting to one-half of 1% per annum, is not very serious for the public to pay,

and it seems to me that some sort of an allowance should be made to wipe off the value of everything that is in use for 200 years anyway.

In Pilarcitos Dam I have considered that the life would be 200 years, depreciation 23%; Stone Dam 200 years, depreciation 21%; 8073
San Andres Dam 200 years, depreciation 20%; Crystal Springs Dam 200 years, 11% depreciation. Upper Crystal Springs Dam 200 years, 80%. This is a functional depreciation in the upper dam. I have not given it very great consideration; in connection with the whole, it is of such minor importance that I simply considered that it was 80% depreciated. I did not, in that dam, include in my annual allowance a sufficient amount to amortize that functional depreciation as well as physical.

The functional depreciation is complete. In Sunol Dam I considered a life of 65 years, depreciation 20%. I am not sure where I got that 65 years; it is a small structure, and it will functionally depreciate by reason of the pollution of waters, unless it is very carefully guarded, and if it is used for 65 years, it seems that it would be rather abnormal; the 65 years corresponds, I think, to the 13 years of life mentioned, which is 20%, and which would be easy to compute. The Niles Dam I have considered to have a life of 50 years, with a 50% depreciation.

Cast-iron pipe I have estimated as having a life of 100 years. I have no reason to believe it will not last longer than that. This makes the depreciation in the City District No. 1, 27%, City District No. 2, 23%, and City District No. 3, 18%.

Tunnels I have estimated as follows:

Pilarcitos 1 and 2, 200 years, 23% depreciation.

Stone Dam, 1, 2, 13, 200 years, 21% depreciation.

Davis Tunnel, 80% depreciation; that was because the purpose of the Davis Tunnel was largely taken up by other structures; in connection with these other structures, it would hardly be applicable to them; that is functional depreciation.

Bald Hill Tunnel, 100 years, 16% depreciation; some time in 8074
the visible future Bald Hill will become too small for its purpose. As the draft from San Andres is increased, and it should be and probably will be with the increased consumption in San Francisco, it will warrant another conduit. I don't know whether the Bald Hill Tunnel will be abandoned, or whether an additional conduit will be built, so I have simply used that in the assumption of life of 100 years. Incidentally, the depreciation allowance, the annual allowance, is doubled by reason of that assumption over the assumption that 200 years would be the life.

Mr. Hazen: It means that if the tunnel is not large enough, that you would have to put in another tunnel. Perhaps it should not be depreciated in that way, but I have looked at it from the standpoint

of a buyer or a seller; if I were representing somebody who wanted to buy this property, and I found that the tunnel was not large enough to serve the needs through a term of years, and that something would have to be done to it, I would consider on something being knocked off; if I was selling, I would concede something; it depends upon how close that is what allowance should be made. In
8075 such a situation, I would say your plant was not built right; this tunnel ought to have been larger.

Mr. Metcalf: That is my idea.

Mr. Dillman: There is entire accord between myself and Mr. Hazen on this point.

Mr. Dockweiler: I think I have the same viewpoint.

DIRECT EXAMINATION BY MR. SEARLS.

Mr. Dillman: The Sunol Tunnels I have estimated at 65 years, and 20% depreciation; Lake Merced Tunnel at 80 years, 20% depreciation; Lake Honda Tunnel 60 years, 16% depreciation; Bernal 100 years, 28% depreciation; Lake Honda Tunnel on Seventh Avenue, 100 years, 17%.

Flumes are variously estimated as follows: Pilarcitos and Stone Dam Flumes at 40 years, 65 and 40% depreciation, respectively. Sunol, 20 years, 50% depreciation; Niles 30 years, 30% depreciation.

The riveted pipe is estimated as follows: Pilarcitos pipe 50 years, 50% depreciation; Stone Dam Syphon 60 years, 50% depreciation; San Andres 60 years, 25% depreciation; College Hill 60 years, 75% depreciation; Ocean View 60 years, 60% depreciation; Crystal Springs 70 years, 40% depreciation; Niles 40 years, 60% depreciation; Alameda 60 years, 25% depreciation; Lake Merced 50 years,
8076 10% depreciation; Lake Honda 60 years, 16% depreciation; Central Pump mains 60 years, 5% depreciation; City Distributing System No. 1, 60 years, 47% depreciation; City Distributing System No. 2, 60 years, 41%; City Distributing System No. 3, 60 years, 43%.

These different lives were put down at different times, and there was no attempt to make them agree, and I don't know that such a move to make them agree would approach the truth any closer than the estimate as it is.

In regard to these lives, I have not had a great deal of experience with structures that are played out, and I depended to a certain extent upon the best information I could get, by reading and otherwise, and I don't know that there is any need to read these into the record. I have a good many schedules of proposed lives of structures for valuation purposes, some of them by Mr. Metcalf, and I presume that they are the result of a considerable study; there have been a great many writers on depreciation. I have read a great deal on the subject. I have never seen but few cast-iron pipe that had deteriorated to zero, and those only in cases where the attack was

from the outside from salt water. I think the concensus of opinion of the various writers on this subject is that cast-iron pipe should be estimated to have 100 years of life, and I think that is probably the reason I have taken it, though I have no doubt some of these pipes will last considerably longer. 8077

I went over the structures of the Spring Valley Water Co., but I cannot say with a great deal of care, with the view of forming my judgment on depreciation, and I think in a majority of cases my estimate of depreciation has been from the assumed life and the stated age, rather than an inspection. The depreciation of the pumping machinery is an adopted one from E. P. Jones' estimate. It is not my own estimate. The total value reproduction cost is $621,000, the pumps $224,000; present value $397,000, and the depreciation allowance $15,556. That would make approximately 40 years as my assumed life for the main units.

In the appraisal of the Freeport, Ill., Waterworks, the engineers appraising it, Mr. Alvord, Truneaure, and Marston, gave the life of cast-iron pipe, 4 inches, 75 years; from 6 to 16 inches, 100 years; for wrought-iron pipe, 25 years. I have generally used 60 years. If what they referred to was small wrought-iron screw pipe, I have used 30 years. For cast-iron specials on street mains, 100 years, boiler plants 25 years; pumping stations, such as we have here, building, brick smokestacks, pumping engines, Holly-Gaskill, 35 years. That is not the type of engine that is in the Spring Valley pumping stations, but it is a good type of engine. For water and drain pipes, and appurtenances in buildings and grounds, 60 years; meters 25 years. I don't know whether they applied those on the sinking fund method or not. 8078

Mr. Hazen: It makes a fundamental difference in the probable lives whether they applied the sinking fund or the straight line method, because, to get a fair result with the straight line method, you have to use entirely different lives from what you would to get a fair result with the sinking fund method; when it comes to boilers, the life can be known with some degree of certainty; it is not altogether speculative, but as to pipes, nobody knows just what the life is. The only way that they estimate the life is to take a life and use a fair rate of depreciation, and apply it in a certain way; if you use the sinking fund method, you get a shorter life, and if you use the straight line method, you get a much greater life with the same data; and to take the life that goes with the sinking fund method—and I think it is so with what Mr. Dillman has read—and then apply those figures to the straight line method, it seems to me would produce a result which the data, and which the authors would not have stood for quoting at all. 8079

Mr. Metcalf: As a matter of fact, that question has actually come up, as Mr. Hazen says. I have found that in the Middle West

a certain corps of engineers, of which Mr. Alvord was one, has on a number of cases, assumed varying rates of interest in figuring their sinking fund, varying from 2½% for the 100 years life, and 4% for the shorter lives, and the amounts varying between those limits, on the theory that the longer the life, the greater the speculation, and therefore, the more conservative they wanted to be; the result was that when I came to act with Mr. Alvord in one case, I said to him that I had been in the habit of figuring with the 4%, and he wanted
8080 to do the other, because more of the engineers of that locality had used that method, and I said "All right", and each time I had in mind in a general way what it would amount to on the 4% rate, and he was figuring on 2½% rate, and then we compromised our judgment on the length of life which we would establish; so that I think Mr. Hazen is absolutely right in saying that certain engineers, at all events—I confess that I am one of them—always bear in mind the resulting annual rate which they get, as much as the rate which results from the assumption as to life, and I think it has, as a matter of fact, modified my judgment in many cases as to the length of life which I have assumed, because I have assumed that the results which I got, perhaps, were too low, or were too high for that particular case. I do not mean that I figured out about what I thought I ought to have in the way of an annual allowance for depreciation, and then worked out my probable lives from that. Mr. Hazen and I do not agree on this question, but this is the situation: I have used the sinking fund method of computation more as a yard stick, and have referred everything to that. I might have started in the other way and assumed a certain percentage for pumps, and then compared different plants on that basis, only it so happened that I did begin on the other basis, because others were doing it, and so I have compared the results on the sinking-fund basis, but I have not hesitated to modify the length of life if I felt the percentage was too high or too low, that is, the computations were too low or too high.

Questioned by Master.

8081 Mr. Metcalf: I start in the first place with a theory of the length of life; it is modified then by the conditions which I finally find on the ground; if applying that theory of a certain length of life and certain rates leaves me with a certain percentage of accrued depreciation, I compare that with the condition of the structures as I see them, and if it seems too much, I may modify the life which I will give to that structure, or if it is too small, I do the reverse. In other words, it is substantially a modification of the application of the sinking-fund method in the light of the observed conditions as far as the structure goes, or the possible future life history anticipated for the plant.

The Master: It seems to me that you and Mr. Hazen are prac-

tically at one in determining the result, only he does not, in many cases, consider total life, because he thinks it is an unnecessary sequence on his first determination: Isn't that about it? I always started in on the length of life, and worked from that, but when I asked Mr. Hazen, for example, why he adopted 13%, it was evident that his determination of that was obtained from other considerations; as I remember, he said that was its loss in carrying capacity—it was about some pipes—that might be one reason for getting a rate of 13%; then you could figure it into lives on the sinking fund bases as you chose.

Mr. Hazen: I did not take the carrying capacity as the sole criterion; I considered it as one thing to be considered. 8082

Mr. Metcalf: I think the result is probably due to the way in which I go at it. I give, perhaps, some greater weight to the obsolescence theory than Mr. Hazen does, because starting with the ordinary life history in that way, and then modifying it to the conditions, my result is somewhat greater as regards accrued depreciation, than Mr. Hazen's, and also on the annual allowance it would indicate probably that I have given somewhat greater weight to that factor.

DIRECT EXAMINATION BY MR. SEARLS.

Mr. Dillman: In the Municipal Journal & Engineer, volume 23, 1907, in the valuation of waterworks plants, by C. B. Burdick, of Chicago, he gives the ordinary life of waterworks structures; well coated cast-iron pipe and specials, 75 to 100 years; wrought-iron pipe well coated, 25 to 50 years. I think that is small pipe. I have assumed 30 years; buildings 25 to 50 years; reservoirs 50 to 100 years; pumping machinery 15 to 50 years; boilers 10 to 20 years.

In the Engineering News, volume 41, page 283, the board of engineers appraising the Los Angeles City Water Co., Messrs. Schuyler, Adams, Koebig, and Lippincott, cast-iron pipe in the better soils, 8083
1.25% per annum, corresponding to a life of 80 years on the straight line basis; cast-iron pipe in the poorer soils 2% per annum; that corresponds to a life of 50 years. Sheet-iron and riveted pipe in the better soils 4% per annum, corresponding to a life of 25 years; the same thing in poorer soils, 6.67%, corresponding to a life of about 16 years. Wrought-iron standard screw pipe, in the better soils, 3.33%, coresponding to a life of 30 years; that assumption is the same as mine; in the poorer soils, 5.71%, corresponding to a life of 15 years. This is dated 1899. In the case before the Wisconsin Railroad Commission, the Appleton Waterworks Case, decided in 1910, the Commission gave a life of 100 years for cast-iron river intake pipe, and Bryan estimated it 60 years, and Sturtevant 50 years. I don't know what method of depreciation the Wisconsin Commission pursues with regard to waterworks.

In the Journal of New England Waterworks Association, Leon-

8083½ ard Metcalf, in 1910, gives the general limits of useful life, reservoirs 50 to 100 years, in which he makes a note, except where subject to heavy deposits of silt. Pumping machinery, high duty in large units, 30 to 50 years; steam engines 15 to 25 years; boilers 12 to 20 years; cast-iron pipe, large diameter, in non-tuberculating waters, 60 to 100 years; in tuberculating waters 50 to 75 years.

8084 I think these waters here are considered as non-tuberculating waters. They certainly have less effect, from what I have seen, than what I have read of tuberculation in the East. Cast-iron pipe of small diameter 30 to 50 years; steel pipe 25 to 40 years; meters 15 to 25 years.

Mr. Metcalf: My impression is that those figures of mine in the New England Waterworks Association Journal were based on the sinking-fund method. I presume they are figured both ways. From the note which you have just read, it indicates that I show what it would amount to in both methods, but in my own practice I have always used the sinking-fund. I use the same lives for both methods there.

8085 DIRECT EXAMINATION BY MR. SEARLS.

Mr. Dillman: The city reservoirs I have generally estimated at 200 years, all except Lake Honda and the tanks. University Mound 200 years, life 14% depreciation; College Hill 200 years of life, 21% depreciation; Lake Honda 100 years life, 50% depreciation; Potrero Heights 200 years life, 8% depreciation; Lombard Street 200 years life, 25% depreciation; Francisco Street 200 years life, 25% depreciation. The estimate as a whole, with some minor corrections, will stand as follows:

Gross reproduction cost $18,364,587.

Net reproduction cost $13,235,319.

That is after deducting accrued depreciation from the gross reproduction cost.

Annual depreciation allowance $251,979. Average assumed life 73 years. Average age, which I wish to change now to the average years at which this depreciation allowance would wipe out the accrued depreciation, 30 years. The average depreciation is 28%; gross revenue, 1913, as given to me by Mr. Metcalf over the telephone, was $3,362,000. This makes the depreciation allowance 1.37%
8086 on gross reproduction cost, or 1.9% on net reproduction cost, or 7½% on gross revenue.

Reverting again to the method of computing depreciation, each method is good, but not wholly so. There was no use in computing by any sinking-fund method until the interest rate was fixed. This is not specially technical, and a computation by that method can be easily made when the rate is established. Any system of estimating depreciation, and an annual allowance therefore, is wrong in prin-

ciple, and must be erroneous in result that does not connect one with the other. The allowance is solely for the purpose of compensating the company for such depreciation. In Mr. Metcalf's Exhibit 160, pages 5 and 6, 6-a, he has added to his depreciation allowance 4% on the accrued depreciation. This seems to me to be unwarranted, and if it is eliminated, will make my annual allowance a greater percentage of value, either original or depreciated, than his estimate.

In the operations of the company I had no knowledge of what was marked off for depreciation. I think it should be eliminated simply because there is no warrant for its introduction, unless you do it to compensate the company for past losses which are assumed, and I don't know what they amount to, nor have I seen any figures to reach that result; but unless they are considered, the depreciation has been equalled by the depreciation allowances, and the depreciation allowance is in the hands of the company, and they are allowed to use it in any way they see fit. They are not hampered by law, as I understand it; they can keep it intact, or they can reinvest it in the property, and if they are making additions and betterments continually, that seems to me to be the very proper place to use 8087
that fund; and to ask the rate-payers to pay returns on it is entirely unwarranted by any of the premises that I have assumed.

Assuming that the company in the past has earned sufficient revenue at all times to pay its operating expenses, and to set aside a fund for depreciation, but instead of setting aside the fund for depreciation, the company has elected to pay dividends out of that money, that would not, in my opinion, justify any company in ignoring the depreciation of its plant in order to pay dividends.

In Mr. Hazen's Exhibit 159, on page 26, he has introduced an item, the second item of the estimate, Spring Valley, the amount of abandoned structures, $3,300,000, and from that, and the subsequent figures, which I have found no errors in, he deduces that the annual rate of depreciation is .99%, and the depreciation as percent of income 8.45%; there is not any more reason for taking up these abandoned structures as a part of this compilation and computation than there is in the attempt to recoup any other losses. These abandoned structures either pay for themselves at the time they were abandoned, or they were a bad investment, and it seems entirely inappropriate that they should recover on those abandoned structures at this late day. If that item is stricken out, and the figures correspondingly changed, Mr. Hazen's returns, based on the annual return for depreciation, the annual allowance would be 4.3%, instead 8088
of 8.45%.

Mr. Searls: Q. In justice to Mr. Hazen, there, I presume that that total income that he gives includes the income which the abandoned structures earned. Have you taken that into account? A. I

have taken that amount, $3,300,000, from both of them. All systems for estimating depreciation and allowance therefor that do not connect them, so that the total allowance equals the total depreciation at the end of life, are right. A corporation of this kind is continually spending money in betterments and extensions and renewals, and they can always use this money to advantage, and for that reason it makes little difference to them whether they get it one way or another, providing they get it. These different systems of estimating depreciation affect the rate-payers directly. It is true that the straight-line method gives bigger payments at the beginning of life than it does later; it is therefore a little easier on the earlier rate-payers, but the difference is not serious, and from some view points it is well that they should pay a little extra. The company at the beginning needs money a little more badly than it does later. The hardship is not onerous.

8089 In my experience utility rates have gone both ways. I cannot say which way they have averaged. I think that they will go down, but there are special considerations once in a while why they have to go up. Some of them are a little specious; but in the operation of municipal supplies in Portland, and I think in Seattle, the rates have been lowered with the advance of time. At any rate, each system is an approximation, and no system can be anything else, because accidents and incidents of operation cannot be accurately forecast. A 5% rate of interest seems about right, but I have no special issue to take with either 4% or 6%. But in consideration of the somewhat doubtful premises as to life, ignoring scrap value at the end of life, and the further fact that error here is partly, if not wholly offset by annual allowance, I can see no reason for a lot of arithmetical gymnastics in the computations. Moreover, it is of so small moment in comparison with the proper rate of return, it seems petty to stick for it. I therefore advise the straight line method. The rate of assumed return on this fund is eliminated, and it is simpler, requiring no explanation, no apologies.

The introduction of the value of abandoned structures seems entirely wrong. If their use during life resulted in no returns, or inadequate returns, there is no reason for collecting now. After the annual allowance is found, it can, of course, be expressed as a percentage on gross reproduction cost, or net reproduction cost, or gross revenue, or cents per capita, or dollars per capita, or a percentage of anything desired. The presumption, however, that it will vary directly with any
8090 of these things, is erroneous. The annual allowance to be right should be such that it in amount, with interest at fair rates, shall exactly reproduce the part in question at the end of life. The premises being all approximations can produce but an approximate result in conclusion. In case the sinking-fund is used, the interest is to be considered.

Whether I took my structures with their full reproduction cost

depreciated as the basis for determining the fairness or unfairness of a rate, or whether I took them undepreciated, does not make any difference; it would simply be a different rate on the two different principles. This is computed on both as giving you a percentage on the depreciation allowance, giving a percentage on the cost new, on the depreciated cost, on the gross revenue—you pay the money and you take your choice.

I think if I were going to use a sinking-fund method, I would 8091
advocate the 5% rate of interest. I don't think it is any of the public's business what the company invests that fund in; they can distribute it as dividends, provided they are ready to dig up assessments if they want to make improvements. It seems to be entirely unnecessary to say what they can do with this fund; it is there, and they can get as much as they want out of it; if they get more than 5%, well and good. 8092

I don't know what the experience of the company has been with respect to depreciation. This matter of public regulation, the handling of depreciation funds, has not always been before the company, but I discard that on these grounds: Historically this water company started as two water companies, and they might have continued as two water companies until one of them went to the wall, and all of these structures were abandoned. There is no reason why the rate-paying public should be required to pay the remaining company for the losses to the losing company, and it seems the same thing occurs with regard to a part of it; if these abandoned structures had not paid for themselves at the time of their abandonment, they should have, and it is wrong to require the rate-paying public now to pungle up to that extent, if there is a loss of $3,000,000, and at any rate, if this matter is to be considered, I would like to have the details of that $3,000,000, rather than attempt to discuss it without the facts. Of course, I know what some of these structures were; there is the Locks Creek, which is entirely abandoned at the present time, and never to be revived; there is the Lobos Creek Pumping Plant, and that I know has been sold to the United States Government; there is the flume through the Presidio, and in general I want to say that a computation in the interest 8093
of justice covering all the operations of the company should not be mixed in here with present rates or present values. The Locks Creek Flume, the Presidio Flume, and the Lobos Pumping Station are of no value to this plant today, and whether they lost or made money when they were in use is not pertinent to this question, and I therefore eliminate them as impertinent.

I don't know that that complete depreciation on the parts of the plant which have suffered complete depreciation, and have been eliminated, has not been completely allowed for during the life of the parts. I cannot assume that they have not until I get the history of the plant in sufficient detail to ascertain it, and that is another long-winded

computation I imagine. If it has been allowed for in the past, it certainly should not be allowed for now.

Mr. Hazen: I am trying to find a rate from the past, of the depreciation that can be used to forecast the future, and estimate the present accrued depreciation. I will admit that the depreciation in the
8094 future probably will not be just the same as it has been in the past.

I think I assumed that all of the abandoned structures were structures that were actually used and useful in the supplying of water to San Francisco. I was not very well posted on all the details of the consolidation of the Spring Valley Water Works and the San Francisco Water Works. I inquired what the discarded property was in this case, and this figure was given to me, and I simply used it. If all of one of the plants was depreciated, there would be something in the item of not charging the rate-payer with depreciation on all of that plant. I happen to know about consolidation, and while there was some waste in the cases that I have known about, most of the property has been useful to both plants; there was some duplication, but a long way from 100%.

8095 I should say that on the assumption which I think a reasonable one, without knowing what the facts were, that the two plants were both useful, one perhaps not quite as useful as they would have been if they had been built together so as not to duplicate it. There is some extra depreciation that ought to be marked off, but it would not be the depreciation on one plant probably, or anything like it; it would be a small part of it.

Mr. Metcalf: If you have two plants to maintain, you would not have consolidation; a consolidation is brought about usually because of the reduction in operating expenses which may result, and the ratepayer gets his advantage in reduced operating expenses which may be assumed to have accrued by reason of the consolidation.

8096 Mr. Dockweiler: As I understand it, at the consolidation of the two companies, such mains as the management insisted were duplicates were sold; another point, the two companies entered different fields, and a great deal of the pipe system was practically useful after consolidation, from the fact that the Spring Valley Water Co., being the younger of the two companies, brought in its water from Islais Creek, and its pipe system, until it reached the older company, which came in from the north and west, and the younger company coming from the south and east, did not give the parallel system which at first thought would suggest itself; in that zone where they overlapped those pipes were disposed of.

If Mr. Hazen has determined the ratio of the property that went out of use through abandonment, what percentage that bore to the structural properties in use, because now applying that percentage to structures that manifestly had cost more, and that are longer lived, would not give a ratio, but something, a line to work along with, but not conclusive.

Mr. Hazen: That is the idea, exactly.

Questioned by Mr. Dillman. 8097

Mr. Metcalf: I have not used this value of abandoned structures anywhere in my computations, except as giving a line upon the probable future annual depreciation.

Witness: ALLEN HAZEN for Plaintiff. Hazen

CROSS EXAMINATION BY MR. SEARLS. 8098

This calculation on page 26, where it comes out .99 of 1% is based 8099
on the proposition that when the plant is constructed at the end of the first year, a certain percentage of the construction cost will be written off in depreciation, and the amount of construction during the second year will be added to that, and then at the end of the year the same percentage of the whole construction account will be written off again, and interest presumably will always be reckoned on the amount of the construction account, so far as this calculation goes. The problem is to find out what rate of percent used in that way from the beginning to the present would account for the whole depreciation, that whole depreciation, including both the depreciation on the existing structures, and the worth of the abandoned structures. That calculation I have made to find out what that percent would be, and the result is .99 of 1%.

This is not my idea of a straight line. I think in the end re- 8100
sults, as applied to this calculation, it is equivalent to the actual depreciation that takes place, because it produces a depreciation which I estimate in the existing plant. As to whether it is exactly fair between the different parts of the elapsed past or not, I cannot say; there may be some inequalities there, and I expect there would be in any method perhaps that could be used, but I am inclined to think that it is perhaps a pretty fair approximation as a practical method of getting at it.

Assuming that the plant had a value of $100, and that the annual depreciation allowance is .99%, that would not mean that in 100 years you would have taken care of the reproduction of the plant over its life, and that you would earn interest on 100% also in addition to that, because when it is marked off it disappears. If you would start with a plant that is worth $100, and you mark off $1 per year, and invest it in the plant, why that presumably keeps the plant up, and at the end of the 100 years, you have still got your plant. I don't think the 8101
original plant would have disappeared at the end of the 100 years; some parts of it would have disappeared; some parts of it would have been replaced quite a number of times, and some parts of it would be left, and I would not apply it to a single item, but simply apply it as a method to an actual, composite, growing plant.

Any percent that we adopt I have always figured should be on reproduction cost in connection with reproduction estimates; that is the only basis I have ever thought of. It seemed that the two things went together. If the cost of reproduction was always going up, the
8102 percentage being fixed, then the depreciation allowance would go up with it, but of course, that is not always the case; the reproduction cost has gone down in long periods of years, and it has gone up in other periods of years; it fluctuates from time to time, and whatever that change may be, I have assumed that the calculation made at any time, and as of a certain date, will be constant with reference to the estimates as of that date.

As I understand it, reproduction costs a little more than original cost. There undoubtedly was a time 20 years ago when the cost of reproduction was very much less than the cost of the works up to that time, perhaps not more than ½ to 2/3 of what the original cost had been; since that time the reproduction costs have been advancing. I think it is true to say that my reproduction allowance would not be mathematically correct for any given year because of these fluctuations in value of any reproduction costs; I think that depreciation allowance is bound to vary; it will vary, not only with the conditions that we are talking about, but it will vary with the management of the company; if the management is skillful, the depreciation will be less, but if the management is less skillful, the depreciation will be more.

8103 I figure on a depreciation based on reproduction cost of the plant to December 31, 1913, without any reference to its original cost, and without any reference to what its reproduction cost would be on December 31, 1930, for instance. I am not very familiar with the methods used by the company in reckoning depreciation in the past. I have heard that since 1908 they have written off $260,000 a year. I do not know what they did before that. It was not customary to write off depreciation every year in any of the old waterworks properties that I have had to do with. I do not see that it makes any difference with the estimated cost of reproduction, or with the value of the property as it stands, whether the work that was built, some in the past, represented new capital, or whether it represented money that was put in out of earnings, and which was an offset to depreciation; the property is here, it would cost a certain amount to reproduce it, whether it had its origin one way or the other, I do not see that that makes any difference. I should say, generally speaking, that in figuring depreciation that it was fair to ignore entirely what the company has done in the past, and start in entirely new on some method or other; there may be some exceptions to that.

8104 If the company had used the replacement method of depreciation, and had taken out of operation each year simply enough to replace those parts of the plant which depreciated, I think I should advocate changing the method at this time so as to substitute the method that

I have adopted; I think that some systematic method of estimating depreciation, and marking it off each year, is better for a property of this kind than waiting until the units go out of service. If in writing off $260,000 a year since 1908 the company had acquired quite a surplus in their depreciation reserve, I don't think I would take that into account in reckoning depreciation for the future. This is on the assumption that it is in money or credit. The ordinary way would be to mark off that amount from the value of the plant, and charge it to the operating account as an expense, and if that is done, there would not be any money or anything to do; but if it had been paid as cash to a separate account, I should invest it in plant.

The $260,000 a year which Mr. Muhlner stated had been invested in the plant must be given account, but with the cost of reproducing a plant and marking off the depreciation that there is in the existing 8105
structures. If your question relates as to whether it would be proper to again mark off so much of the plant as represents the expenditures that had been made by money set aside for depreciation, I say no, because to do that would be to take it off twice. I don't think it makes any difference whether they use that money in new structures, or replacements; they invest it in the plant, and it represents plant thereafter; whether it is new, or replaces old, I do not think that makes any difference at all. I don't think it makes any difference whether it is straight line, or sinking fund, or any other method. The ratepayer is given credit for it in that the depreciation is marked off from the value of the plant, and the amount on which a return is demanded from him is reduced by that amount; when that is done, his claim on that is gone; that has been satisfied.

I should not pay any attention in calculation to that actual pay- 8106
ment of $1,280,000 for the period 1908 to 1916, eight years, but I should use what I estimated the depreciation fairly would be for those years, and I should deduct each year from what otherwise would be the construction account, and the amount on which a return would be expected would be reduced by that amount each year; if that depreciation, or if no depreciation had been written off, then we would have the reproduction cost of the structures without depreciation; and we have a smaller amount, because this allowance has been made, and depreciation has been deducted; so the account is less to that extent.

In figuring my accrued depreciation, I did not multiply the .99% by the weighted average in years of actual life. I estimated for each structure in the system how much, in my judgment, it had decreased in worth by reason of wear and tear and corrosion, and also, as far as I thought it was applicable by what is called functional depreciation; so that it is made up from a consideration of each of the structures as I saw them, and in the light of what I could find out about them. That is a personal consideration by me. That was a determination by in- 8107
spection as far as it was open to inspection, and backed up by any

other kind of information that was pertinent. The amounts that I found in that way by inspection are shown in Exhibit 97, or, rather, the estimated costs of reproduction are reduced by them. I have written in, instead of the depreciation, the cost of overhead less depreciation, and the depreciation is the difference. It is always expressed as a percentage, and the percentage appears in the next to the last column.

ONE HUNDRED AND ELEVENTH HEARING. MARCH 7, 1916.

Witnesses: ALLEN HAZEN for Plaintiff.
LEONARD METCALF for Plaintiff.
J. H. DOCKWEILER for Defendants.
GEO. L. DILLMAN for Defendants.

Hazen Witness: ALLEN HAZEN for Plaintiff.

8108 CROSS EXAMINATION BY MR. SEARLS.

My method involves taking each year 1% of the depreciated value of the property, and deducting that from the depreciated value, so as to obtain a basis for reckoning the following year, and then adding in additions, betterments and replacements made out of the previous fund. The 1% is not a fixed percentage. The idea is to find out what percentage is adequate, and use that. It would not always be the same. The 1% is the one which, applying this method to the history of the
8109 Spring Valley property, from the beginning to the present time, on the basis of records I have had, is indicated as the one that would account for the past history of depreciation. If the 1% is used, I would use it for each year in litigation. In discussing the future, it is a fair consideration whether the depreciation of the future is going to be the same as that of the past, and whether the same rate should apply. I think that I should use the same rate in anticipating the future for a reasonable period, but no one can tell in advance what the depreciation will be, and even after it has occured it can only be ascertained approximately. My method is intended to apply to a composite property, and not to a particular item going to make up the entire system.

8110 In our office in New York we have a method of handling depreciation which is very simple. We carry a property account, everything that is bought of a permanent nature is charged to it, regardless of whether it is replacement or something new; at the end of the year 10% of the face of that account is deducted, and charged to the expenses of the business for that year. That is a crude application. After having carried it out for a good many years, however, we found

that the inventory, made up at fair prices, was getting to be a little more than the face of our account, which shows that the 10% is a little more than the fair allowance. We might make a replacement and say we should use 8% in the future instead of 10%. This method that I have tried to apply to these properties is really doing just that same thing on a much larger scale. On either of the two methods that I suggest here, of percentage of capital, or percentage of gross income, I would rate my investment return on the depreciated condition. There are some people who believe that the rate ought to be calculated on the cost to produce new. I think there is a good deal of force in some of the things they say. If an old waterworks property was in all respects, from an operating standpoint, equal to a new waterworks property, I would be very seriously disposed to think that was the right method; but an old waterworks property, from an operating standpoint, is not ordinarily the full equivalent of a new waterworks property, and it seems to me that this allowance for depreciation represents, in a way, that difference; perhaps it does not represent it exactly at all points. It is an approximation; still taking that into account, I am inclined to think that the fair way of getting at it is to take the depreciated cost of reproduction as a starting point for these calculations.

On my computation, as I have made it here, resulting in approximately 1%, method requires me to rate my investment on depreciated condition, because that was the assumption in the calculation. I stated the two methods in this manuscript, Exhibit 159, page 24; I stated three methods as 1, 2 and 3, but I used 2 and 3. If I had been going to figure the rates on the cost of reproduction without depreciation, I would have used the first method instead of the second, and in that event, instead of getting 1%, I should have gotten a smaller figure. How much smaller I do not know, because I did not make the calculation that way. 8111

Mr. Metcalf: There is an indication of that on page 32 of my Exhibit 160, in which, using my estimate of depreciation, which was somewhat greater than Mr. Hazen's, I got, on line B, column 6, as based upon the depreciated reproduction cost, 1.06% per annum; as based upon gross reproduction cost, 0.93%.

Mr. Hazen: I think perhaps it is true that there is no question of fairness in rating the condition new, or depreciated condition, because it is all a matter of mathematical calculation. If you figure on the whole cost of reproduction, the depreciation allowance that goes with it would be less, but presumably it would be the same either way. 8112

Mr. Metcalf: May it not be that in allowance on continuing property, like a railroad, in which some discretion may be exercised by a board of directors in regard to the renewals of stations and other property so as to keep the actual renewals fairly uniform in amount, that the application of the two methods is virtually the same, growing

out of this fact, that as applied to the property new, you would always use the 100% basis; as applied to depreciated properties, what you find in effect under the conditions which I cite, is that you maintain your property at a certain average uniform standard, which the railroad men speak of as being 70% or 80% condition. Now, so long as you maintain your property at a uniform percentage of service condition, you would get, by the application of a certain percentage to that uniform rate, just as you would in the event that you based it upon the total full value. It is only when you have violent fluctuations from the 70% service basis value that you would get substantial differences in your results. My distinction is in the difference between methods of depreciation, emphasizing the idea of longevity, and emphasizing the idea of service.

8113 It does make some difference what theory you assume for figuring your depreciation, with reference to the magnitude of the amount of the accrued depreciation, which you get by your mathematical formula, as compared with the actual condition of the properties, so far as it can be determined. No injustice will be done if it is understood in advance from beginning to end.

8114 My position as to the straight-line method is this: That if a waterworks plant test by other means than this problem of cost accounting, that is, by actual inspection and knowledge of the history of other plants, show that that depreciation marked off is too great, it would very well follow that your annual allowance is also too great.

Mr. Hazen: As with the lives of structures that have been assumed. If the true value of the lives could be ascertained, it may be that some of them would turn to be much longer than they are, and others might not be so great. But even so, it seems to me that with the class of structures that have short lives, and where we know the history more definitely, for instance, the flumes or the pumps, the straight-line method puts a large excess of costs on the first part of the life of the structure, and too little on the last part. The normal history of a waterworks unit ordinarily is that the low factor increases, it does more work after it has been in use for a while, and it is approaching the end of its useful life, than it does at the start; from the standpoint of distributing the load on the basis as fairly as it can be, the method of apportioning the income strikes me as having a good deal of merit.

I am not particularly enthusiastic about a method which involves an assumption of the estimated life, because of the impossibility of,
8115 in all cases at least, estimating with accuracy. There is the other point that seems to me important,—the structures of a class do not have the same lives; for instance, if you say that cast-iron pipe has an average age of 100 years, if you lay 100 miles of pipe, you take up some part of that 100 miles within a year. That is waterworks experience. You take up some of it every year; nobody knows how long

the last part of it will be in service. Now, supposing 100 years is the average age of all that pipe, then the depreciation computed by the sinking-fund method, or the straight-line method, and replacing that pipe in 100 years, will not be the amount that will actually replace all the parts of the pipe when they have to be replaced; it is an entirely different matter; the divergence between the average payments required to meet the different parts of the replacement at different times, is a very different thing from the payment that goes to make the average of the whole. It is only necessary to write down items that will average 100 years, or any other time, and get the amounts that go with those, and compare them with the amounts that go with the average of the whole, to show that there is a very wide divergence. I think the method is defective in that respect also, and in making that remark I assume that cost and reproduction cost are the same.

Mr. Metcalf: I think that stricture, in a general way, is justified. I think, on the other hand, that in discussing the sinking-fund 8116
method and the life of the structure, the chance of my making a serious error, growing out of the consumption of life, is rather less than if I start in attempting to guess the actual percentage, because it makes less difference; in the long-lived structure the effect of an error of 10 years upon the percentage which I would have is comparatively small. In attempting to estimate that percentage, in the first place, I should have far greater difficulty in weighing those effects. I think it is a little easier for me, personally, to give somewhat greater weight to the question of the possible obsolescence of the structure. I am not so apt to overlook that in estimating in that way.

I think what will actually happen is this: As time passes, let us say 100 years from now, I think we shall be on the basis that Mr. Hazen suggests of discussing things on a percentage basis, or some such basis, in the light of the history of many plants, or many structures of like character, and then modify those results; but until we get that experience, I feel as if I were making more accurate comparison of the conditions in different plants by referring it to some such yard stick as that which we used. As a matter of fact, we both consider the condition of the property, and what, on the face of the experience with that particular property may seem reasonable in reviewing the results which we got, he, by a discussion of the percentage, and I by a consideration of the life, and the percentage which results from that.

Mr. Hazen: I have here a paper by Alfred Erickson, the Chairman of the Wisconsin Railroad Commission, presented at a conference 8117
in Philadelphia last fall, in which he states:

"Much has been said about the relative merits of the straight- "line and sinking-fund methods of providing for depreciation. With- "out going into details in this matter, it can be said that the sinking- "fund method implies a more efficient use of reserves. It also means "that because of such use, the amounts the customers will have to

"contribute to cover depreciation is less than under the straight-line "method. The inference that can be drawn from these facts is that "the sinking-fund method is the most economical, and hence, would "also seem to be the best of the two methods from the point of view "of public interests."

I think that may be taken as settling the question where lives are quoted in railroad matters in Wisconsin, that they refer to lives used in connection with the sinking-fund method, and not the straight-line method—I mean as applied to waterworks structures.

8118 Questioned by Mr. Searls.

Mr. Hazen: My accrued depreciation was computed by an inspection of the properties, and a determination of their present condition, and the percentages of conditions new. I made no inquiries with reference to what sums the company may have expended in the past out of earnings for replacements, whether it was charged specifically to a depreciation fund or not. I was simply trying to find what the facts were at the time of the inquiry.

Questioned by Mr. Greene.

The depreciation fund, to which Mr. Searls referred yesterday, would not make any difference with my estimate. If things have been done that were quite divergent from my estimate, it may be that there
8119 would be some equitable consideration within the statute of limitations that might be considered and corrected. I don't know whether there would be or not. So far as my estimate was concerned, it would not have made any difference.

Questioned by Mr. Searls.

Mr. Hazen: Supposing that for many years the company had charged rates that were so high that it could, and actually had charged off the whole value of the plant to depreciation, so that it did not stand them in a cent, what is the value of the service today? It seems to me that the plant is here, it has value, and the service must be rated on the plant as it is. The fact that the customers in a former generation have paid more than fair rates is another question. That is assuming the extreme case. Whether the rates were excessive in the
8120 early years of the Spring Valley Water Co., I don't know. I have no reason to think they were, but they may have been for all I know. It would not make any difference in my judgment of the value of the property, and of the work of the service if they had been excessive, or if they had been deficient. That is when I am addressing myself to accrued depreciation particularly, getting at the value of the property as a rating base. Whether the past allowance was too much or too little, I neglected in my calculations. If there is any obligation to make it good between the two parties, that is another matter; it has not entered into my calculations.

Questioned by Mr. Greene.

Mr. Hazen: I should say that there is not any exact relation 8121
between the allowance for accrued depreciation and an annual allowance for depreciation. Of course, there might be some limiting depreciation. That is to say, if we were to estimate an annual depreciation of half a million dollars, and a total accrued depreciation of a 8122
million dollars, or two years allowance for an old property, I would say on the face of it that that was absurd and unreasonable. I do not recognize that there is any fixed ratio that can be determined and insisted upon. The ratio could be ascertained from my calculations; but the two methods that I have made are intended to be such that if they had been made from the beginning they would have produced the present result, so I would say that they are strictly consistent. I would not say that that bound the fair allowance to be made at the present time, that an allowance that was out of harmony with that ratio was necessarily unreasonable; it might be that the plant at the present time was more permanent, or that conditions might have changed in various ways, and there might be other reasons for modifying the percentage; if there were such reason, it seems to me it would be modified, and then the ratio that is shown by the calculation would apply.

Witness: LEONARD METCALF for Plaintiff. 8124

CROSS EXAMINATION BY MR. SEARLS.

In giving my estimated life on cast-iron pipe at 87 years, I did Metcalf
that with the sinking-fund method in mind. I did not assume that the water of the Spring Valley system would be harder on cast-iron pipe than our Eastern waters. I thought the conditions on the whole were somewhat more advantageous than in the East, though the difference is not great. I think the age of 87 years is somewhat less than has been taken by most of the Eastern commissions and rate-making bodies for cast-iron pipe in distribution systems. I think that more often is taken as 100 years.

In arriving at my estimate of life we had made such examinations as we could of the pipe systems, and I had that before me. I think I have had in mind perhaps also the question of what I should feel perfectly confident was a safe allowance from the point of view of what we know upon the subject; I could not justify an 87 years life any more than I could a 120 years life. I think the fact of the matter is, probably, that we shall all of us find that pipes of 12 inches or larger in diameter will have a much longer life in fact than we have assumed heretofore in waterworks practice, but it seemed the conservative thing to do, and it is in line with what I had heretofore, the result perhaps of my experience in this field; but we have not the data 8125
to say definitely what will happen.

Questioned by Master.

If you were to suppose that I had taken 50 years, and that I should have taken 100 years, then my annual depreciation allowance would be too large, as would also be the accrued depreciation. My annual allowance is consistent with the accrued depreciation; I have used the same rate in figuring the annual allowance that I have the accrued depreciation. On the 4% sinking-fund basis on 100 years it is .08 of 1%, and on 50 years it is .65, about 2/3 of 1%; on a 5% basis the amount becomes respectively .038 of 1%, and about .48 of 1%.

CROSS EXAMINATION BY MR. SEARLS.

In estimating my accrued depreciation on these different items, I have taken both the inspection and the lives that I have assumed into consideration. In some cases, for instance, I have assumed that the life would be shortened on account of obsolescence, and there the obsolescence rate has controlled rather than the inspection rate. That was the case on the Ocean View Station.

8126 I assumed certain lives, based on my general experience, and computed my accrued depreciation on that assumption. I considered it from the point of view of life, and then saw the result I got, and unless that seemed unreasonable, I adopted that result.

If the rate base is to be reproduction cost new, then you would take the accrued depreciation as I have figured it, and the annual rate as I have figured it, excluding the 4% allowance. If, on the other hand, you figure it from the point of view of the depreciated value, I mean, use the depreciated value of the property as your rating base, then you would add that 4% allowance. In other words, I used the addition merely to connect up the results which I have gotten by the
8127 application of the sinking-fund method with the equal-annual-payment method results, which are shown in the last two columns of my table. I do not think it would make any difference at all with the amount that I figured that percent on if I knew the past practice of the company in that respect. I am trying to arrive at a result which may correctly represent the condition of this plant as I find it; but when you come to consider the value of the property as a whole, and what is equitable, as between the city and the company, I think then you may take into consideration the fact as to whether the company has been permitted to earn an equitable rate of return, such that it may be assumed to have provided, not only for operating expenses, repairs, taxes, and a fair return on the fair value of the property, but also a fair depreciation allowance which would in fact maintain the property.

It is my theory that the rate-payer should return to the company the value of its property rather than the cost. I have been thinking of the question which you asked me a day or two ago, Mr. Searls, in regard to whether you should base this depreciation allowance upon

original cost, even though you are now discussing reproduction cost of the property, and it has occurred to me that I might put my answer in this way in order to show you my view-point: As I understand the legal point of view, it is that the investor shall have his investment kept intact; in other words, he is entitled to maintain the integrity of the property through this depreciation allowance. Let us assume that he made his investment years ago, and that the reproduction cost to-
day is much greater than the original cost. If it is, you figure the 8128
depreciation allowance on the basis of original cost, and not reproduction cost; when the particular structure, or group of structures under consideration goes out of service and has to be replaced, he will have in hand the same amount which he originally expended upon these structures, but by reason of the advance in market conditions, he will not be able to rebuild the structures, nor will he be able to do with that money the equivalent which would give to him the same amount of useful work that he was originally able to do with that sum of money. In other words, by reason of the advance in prices, the purchasing power of his money has fallen, and his investment is no longer intact. He can neither reproduce that structure at the same cost, nor can he invest his money to the same advantage in another field at the same cost; in other words, he is not made whole. On my hypothesis the investor is not able to make as advantageous investment in other fields, and make just as much return on his money as he was originally in putting it into the waterworks. The hypothesis which I made was that the reproduction cost had advanced in this period of years. In the same way, if the reproduction cost has declined in the period of years, then, in order to make him whole, you need not repay him the amount of his original cost, but a sum less than the original cost, by the decline in cost, or, to put it in another way, the increased purchasing power of money.

It is my assumption that the rate-payer is obliged to return to the original investor the purchasing power of his money. If you
make the assumption that if the original investor got his property 8129
itself rather than the money he put into it, I might reach my conclusion, provided none of the structures have gone out of service. I assume still that if I were discussing original cost conditions, and reproduction cost conditions, I should aim to apply to the original cost a depreciation allowance commensurate with original cost, and in discussing reproduction cost, I should discuss the reproduction cost, but when I came to the point of reasoning from cost to value, it seems I must give consideration to the fact which I mentioned; in other words, the value of money, or the purchasing power of money. The only reason we are discussing reproduction cost here is that it enters into the question of the value of the property, and the constitutional guarantee is against taking the property without
due return. 8130

If I were appraising here on investment basis, I would rate my depreciation on original cost, and would not be talking about reproduction cost.

Questioned by Mr. Dillman.

Presuming that equity has been done in the past, I have assumed that the accrued depreciation has been returned to the company. The accrued depreciation, and the depreciated cost add up to the same amount as the cost new. In computing my depreciation allowance, I have computed approximately 1% on the depreciated value,
8131 but I have not added to that 4% on the accrued depreciation. On page 5 of my exhibit, in the first summary there, is shown 4% on accrued depreciation, but the first figure of the annual depreciation rate corresponds to the gross reproduction cost. When you first asked your question, I thought that you were referring to the next to the last column. In that I base my computation on the depreciated value of the property, and the anticipated remaining life for that depreciated value of the property. In the column to which you have referred, I have based my annual allowance on the total life of the property.

Questioned by Master.

If you will return to the report of our committee, which gives on page 34 a statement with regard to the equal-annual-payment method of computing depreciation—as an illustration a property item having a 20-year life is taken, which when new has a value of $100. The depreciation allowances are based on the 5% interest rate. On that
8132 basis, if we use the sinking-fund, and at the end of each year assume that the fund itself shall earn 5% rate of interest, we need set aside for that item each year but $3.02. At the end of the 20-year period then, we shall have set aside $60.40: That is all. The fund then must itself earn the difference between that $60.40 and the $100, and it does that through the agency of the compounding effect of 5% on that $3.02 each year. Under those circumstances it is clear that unless the rating basis is taken at $100 for each and every year throughout the life of that unit structure, injustice will be done to the investor because he will not be getting a return upon his property throughout that time, unless you do allow him his rate of return upon the full value of the property; you may not assume that the interest upon the accumulating fund, in other words, the interest upon the accrued depreciation fund, is part of his return, because if you assume that it is part of his return, you will not have in the fund at the end of the 20-year period any more than $60.40, where he would be entitled to $100 at the end of that time. If, on the other hand, you assume that the fund need not earn its own interest, but you regard that as an amortizing of capital to pay back, not only the $3.02, but the interest compounded annually, then you may deduct the amount of depreciation allowance each year at the

end of the year, and allow him a rate merely upon the depreciated value of that structure. That is exactly what I have done here.

Questioned by Mr. Searls.

The sinking-fund method gives the company the money, and it then can invest that in the plant just as well as in the straight-line 8133
method. The accounting of the compounding of the interest is a little bit more difficult a bookkeeping problem. From that point of view, the straight-line method is easier, unless you do this: If you invest your fund in the securities of the company, then you simply clip the coupons, add them to your fund, reinvest those in additional securities, and it is no more difficult. If it goes back into the property, then of course the property itself must be permitted to earn a return, but that return must be accounted to the fund. The logical thing to do always with your depreciation is to reinvest it in plant. If you have a sinking-fund, from which your replacements are being made, we will say you expend $100 for certain replacements the first year, and that replacement goes into the plant, and is worth $100, then and at all times. You are going to compound your interest each year on that particular item so as to bring out the fund at the right figure at the end of the life, because you keep note in your system of accounts of the total amount of the sinking-fund, and you simply figure your 4% rate on that, and account that; you don't consider each structure; you usually carry it in one account. You may distribute it as between various accounts, but that involves great difficulties in accounting. In other words, you would charge your interest against your earnings. The total 8134
annual depreciation allowance plus interest which should be allowed in this case on the theory which I have used, would be identical with the total depreciation allowance plus interest if the Master should adopt the straight 4% sinking-fund basis, and allow a return on the value new of the property, and the result is also approximately the same as would be gotten by figuring the annual rate which should be allowed to amortize the depreciated value of the property in the anticipated remaining life estimated for the several structures.

Questioned by Mr. Greene.

There is not any necessary relation in my mind between the accounting allowance and the actual depreciation. In the accounting allowance we assume average conditions corresponding to certain theoretical bases of amortization which have been assumed. By actual depreciation, I mean depreciation which has actually taken place, as ascertained by inspection. The average of that amount, taken over a period of years, would be the amount which would be the average of one year, and that is just what happened at the time of the earthquake.

8135 Witness: J. H. Dockweiler for Defendants.

CROSS EXAMINATION BY MR. GREENE.

In determining depreciation, I take into consideration the condition of the structures. That is one of the means I have of determining in my mind the life.

If the Sunol Tunnel No. 4 were built in 1913, and I were valueing it as of 1913, I would give it its full value, as there would be no depreciation in it until it was a year old, and that would be only a functional depreciation. I think the tunnel, as it stands there now, is just as good as when it was built. Taking the fact that the tunnel
8136 was in as good condition in 1913 as it was at the time it was built, there would be a greater allowance on account of functional depreciation in 1913 than there would have been had it been built in that year, because that is the annual contribution; there is no way that I know of that you can determine the annual contribution if you omit or eliminate the estimated life. The total accrued depreciation is a measure of the annual depreciation, applying it to the units, and I have thus determined the total depreciation by determining the annual depreciation of each unit, and thus arrived at the total, which has given me the annual depreciation, and also the total accrued depreciation.

My depreciation allowance is based on actual physical condition, for the reason I examined a flume, and knowing the time it has been in existence, I determined that that will have a life of 35 years, and it is an admixture of all the facts; you cannot say what is controlling. I examined the steel pipes; they have been in use so and so, and I estimate that their condition is about so and so, and taking into consideration that the physical deterioration that is evident does not give you an indication of the full deterioration owing to the impossibility of ascertaining it—to instance, we know that a hoisting cable will last about so long, yet, judged by its appearance alone, you would
8137 say there is not anything that will warrant you in assigning that so short a life, but you do know from experience, and from the conditions under which that cable is being used, that it has just so long a life, and that you are not warranted in assuming any longer. Experience shows that a car wheel is good for just as many miles, yet the physical evidence of deterioration or wear isn't there to justify the amount of depreciation that you would charge off on it, but it is existent nevertheless. Take a piece of timber; you may be able to determine physically very little deterioration, but that it has deteriorated is a fact, nevertheless, so that when you are at those things, when you view them, you have to keep that in mind. Take a pipe, for instance, you may examine a piece of it and it has very few pits, but you know that the time is coming when that pipe is going to be pitted, so that it does not pay to repair it, and you have

got to throw it away; so the inspection method does determine, and it is a method that I have employed to the best of my ability. I have gone on the ground and viewed these structures, and made that deduction. It has stood up under its use, and it will last so much longer; here is its condition; as a structure it may last a great deal longer, but as a structure in use it will be cast aside, in my opinion, at the end of a certain time.

Taking the Sunol Tunnel, and assuming that it was built in 8138
1900, under the functional theory it has depreciated 13% on an estimated life of 100 years. There is no physical depreciation at all; it is only functional. In other words, you might say it has 100% efficiency, it is just as good as when it was built. There is no difference between that tunnel physically now as against the time if it was built today, but the depreciation which goes against it is a functional depreciation. It is my opinion that it won't be in use after 100 years. I took 100 years as an average for the life of tunnels; I could not give any reason why I should not have taken 90 or 110, but that was my opinion that those tunnels would be in use in one form or another for 100 years.

Supposing one of these tunnels had been built in 1900, another in 1910, and another in 1913; on the theory which I have employed in this case, I would depreciate one of the tunnels not at all; the other based on a 10 years past life, and the other on a 23 years past life. I do that by averaging. For instance, if a tunnel was built 8139
in 1900, that in my opinion had a life of 100 years. The one that was built in 1910 would only have an estimated life of 90 years; in other words, I assume that all of these tunnels will cease to be useful at the same time. That is, the oldest of them will be in use 100 years from 1900, even if there was one built in the same system in 1930. That one would only have an estimated useful life of 70 years, according to my theory, but in getting down to that refinement, strictly to be true to the theory which I employed, I should have differentiated, and if one tunnel were built 4 or 5 years later than the other one, that tunnel should have had an estimated life just that much less, so that all of these tunnels on the Sunol Aqueduct should have gone out of use, according to my assumption, in the same year. I think I have given them all 100 years average. It is not my theory that one of the tunnels would go out of use 100 years from the time of its construction, and a later one 100 years from the time of its construction; I have averaged it. If you take the Sunol Aqueduct from the dates whenever those tunnels were built, I assume that they will have a life of 100 years in use. If that Tunnel No. 4 was 8140
built 10 years later, it would have an estimated life of only 90 years, so that the tunnels of the Sunol Aqueduct, in my opinion, will all go out of use through obsolescence in 100 years. The Sunol Tunnel No. 4 will go out of use 100 years from the date of the construction

of the first Sunol Tunnel, but I give an average of 100 years for all of them, regardless of the time at which they were built. That applies also to the tunnels on the Peninsula, and there is no physical deterioration of those tunnels that you can notice.

8141 I have taken 100 years life; basing it on the Peninsula, those Sunol tunnels would have had just that much less life; in other words, some of the Peninsula tunnels were driven in the seventies, while these Sunol tunnels were driven about 1900, so that the Sunol tunnels would have had 30 years less of useful life than I have assigned to them, but there is this to be noted also, that they are on the Alameda System, which is a different system. That does not affect their physical condition. The best test is that you could not tell the age of these tunnels by looking at them; the work is good. I did not come to any conclusion as to whether the Peninsula tunnels are going out of use prior to the time that the Sunol tunnels go out
8142 of use. There are so many possibilities in connection with the Hetch-Hetchy water supply, and the handling of the company's waters, the possibility of the State Commission of this state coming in and saying "We have the superior use, and are going to allow you to "transport so much, and leave here so much"—that there is too much speculation to go into it. I did go into it, and resolved it in favor of the company rather than against it, because the shorter the lives of the tunnel relatively, the greater would have been the accrued depreciation, and letting the depreciation account run over 100 years, it is practically 3 generations; it was just a question of judgment. If I were asked why I did not take 90 years, or 110 years, I could not give you any reason better than to state it was my judgment; but for the Peninsula, I can see where the increase in the growth of the City of San Francisco will necessitate a realignment, if you may so state. The basis of my depreciation of these tunnels here is functional; the growth of the city, and the possible co-ordination in these various sources of supply. I take the same allowance on the Sunol side, because I took an average. Assuming that the tunnels on the Peninsula were in 1913 fifty years
8143 old, and the Sunol tunnels are 10 years old, the functional depreciation should not be the same allowance for all of the tunnels as of 1913, because those on the Peninsula have been in use longer. I am giving you an estimated life of 100 years of each structure in use, and if it has been in use 50 years, 50 years of its life and value has gone. If it had been in use 90 years, it would be worth only 10%, and if that were my assumption, I would assume that these tunnels would go out of use in 10 years more. If they had been in existence 99 years in December, 1913, I would say that these tunnels were worth 1/100 of the amount which I put on them; in other words, they would go out in one year, and that is having them in exactly the same physical condition that they were in in 1913. If they were

105 years old, I would make an estimated life; I would not get a negative result, that is obvious. For instance, you may assume pipe, this little screw-thread pipe, you take an average of 30 years. You 8144
may run across one that will last longer, but your average will still hold good, because some will have a shorter life.

My depreciation account of $8,500,000 out of a total construction account of $22,500,000, or 38%, roughly, seems to me a reasonable allowance under all the circumstances. The average age of these 8145
properties I should judge to be over 19 years. It must be longer, because there are pipes in the system now that I guess are 50 odd years old. Whatever it is, I still think that that is a reasonable allowance.

For instance, if the depreciation measures only what you can see, why then there might be some hypothesis or grounds for it, but I contend that there is a depreciation which you cannot see, which is existent, nevertheless, and I have cited to you the instances; it is going on, but you cannot measure it; a flume may look in good shape, and may be kept up and repaired, but you will find that at the end of 35 years it has to be replaced, because it does not pay to keep patching it up, and the same thing will happen to your pipes. I have not really given it thought in percentages of the whole; the 8146
deductions that I have made piling it up by units, I think are fair.

RE-DIRECT EXAMINATION BY MR. SEARLS.

For the structures that have gone out, there is a complete measure of depreciation, but while some of these structures have gone out, there are structures still remaining which have not gone out, and you are including the measure—if that $3,000,000 worth of structures that have gone represented the total depreciation of the system up to a certain date, then there might be something in the point that in taking into account the depreciation of the whole structures, including the structures which are out of use, that one must bear in mind that there are $3,000,000 worth of structures that have gone, and that you cannot see at all, and that any offhand impression gotten of the plant without considering those would very likely be erroneous; but that was the visible matured depreciation, and it carried not with it that unmatured depreciation of the structures which are still in use, and which have been carried on forward into the present system; that may have measured the depreciation of the $3,000,000, if the $3,000,000 worth of structures went out, but there might have been $6,000,000 or $8,000,000 in use, of which only $3,000,000 went out, but part of that $6,000,000 or $8,000,000 has been carried into the present estimate, and is part of it.

RE-CROSS EXAMINATION BY MR. GREENE. 8147

In my opinion the straight-line hits the depreciation of waterworks structures closer; the observed deterioration seemingly is

slower, but that isn't all. I don't know as any human being knows whether the depreciation goes on evenly from year to year; but as against trying to take the curved line, which is varying as the rate of interest, it is on a pathway that is absolutely broad and straight, as against this curved linear proposition which can be above or below the line as the will whispers and the hardness of the money market dictates. How are you going to get at it? For small lived structures you will say, if they are small lived, we will take the straight-line; there is no difference in principle. If a structure that has 10 years of life is to have its depreciation measured by the straight-line, there is no reason that I can see why a structure that has 50 years of life should have its depreciation measured by a line other than a straight line; if it is wrong in principle in the long-lived one, it is wrong in principle with the short-lived one. This curve line basis has only come in recently, and I think that is against it. Before people thought along straight lines; now we are getting to be on a curve line proposition.

8148 You cannot compare human life to the depreciation of a structure. Under the straight-line you are going to have things averaged; you have got pipes that are coming into use all the while, and in a waterworks where there are great numbers of similar structures, it will balance itself just as on the same proposition as ties—a tie has a life of 8 years; charging off 1/8 each year, you have the straight-line system. The point has been made that we ought to take depreciation on earnings. It is urged that the straight-line is more expensive on the consumer in the beginning. The consumer pays interest and depreciation, taxes and repairs. The taxes are not the heaviest in the very beginning; they are increasing as you get along. The repairs are getting heavier in the latter part of the life of the structure; the maintenance and operation is more expensive with the older structures than it is with the newer ones, so that those things have a tendency to balance themselves. You cannot simply say there is more service being given by a structure in the latter years of its life than the earlier.

The Pilarcitos Reservoir, or the tunnel leading therefrom, has been running about as much water through it in each year of the past 30. Why shouldn't that have a depreciation annually the same? Take pipes; there may be pipes that are laying in the out-
8149 lying districts that in earlier years ran more water through them than they do now, and where in its early life it ran more water through, under the curved line theory you would have to reverse conditions. The straight-line evens out all these things, and says each year, "You shall pay so much". It is well known, I think, that the consumer has the right, if justice is rendered, to elect which way he will pay his bills, because under the curved-line he pays more money than he does under the straight-line in the life of a structure;

you may juggle the figures as you will, but I showed in my testimony in the Contra Costa case that the consumer pays on the full value of the structure during its entire life, and that he lays aside such a sum annually, which, if put into a fund, will pay back the cost of the structure at the end of the estimated life. You may call it an equal-annual-payment, but I can show you that under the equal-annual-payment the consumer pays the interest on the depreciated value; he contributes this sinking fund, and he also pays interest on the sinking-fund, but it is not a fund that is set aside and given to the company; so that it is just merely taking a set of figures and making them fit over to your own theory, but the fact is that you are paying this sum, and no matter under what sugar coating of logic you give it, the bill is there.

I do not think that the structures in this system are performing less service now than they did in years gone by. The city distribution system has been extended now to serve a greater number of 8150 consumers; the same reservoirs are in existence, and your pipe lines leading in from the reservoirs are carrying more water. If a pipe is just carrying what it will by gravity, that is its capacity. By putting on a booster, as they have done here, you can send more water through it. By putting all the water you can through those pipes at this time, you are straining the system; it has not the co-efficient of safety that it had some time ago. The storage is the same in the city as it was several years ago, and yet the daily draft is more, so that your factor of safety has been diminished just that much. Taking that part of the Alameda pipe line from the Ravenswood Booster into Belmont; it hasn't the factor of safety under the present booster conditions that it had formerly. It is being subjected to a higher pressure, and also to a pulsation stress that it was not subjected to when it was merely serving as a gravity conduit; I have no criticism to make of that, I merely state it as a fact.

The visible depreciation shows itself more as years go by in ordinary waterworks structures. The amount of functional depreciation is constant, but functional depreciation, as a matter of fact, actually happens on the instant, because the minute you have de- 8151 cided to put it out of use, then it comes in so that under my theory I know of no other way of handling functional depreciation. The functional depreciation must be a constant year by year; it cannot be a depreciation other than that of accounting. It does not necessarily follow that if that is a constant, and the visible depreciation is decreasing as the years go by, that my depreciation decreases as years go by. To give the application: The flumes will have a life of 35 years, and they will lose 1/35th of their value each year; the two together make for a shorter life, but the flume loses in value each year just 1/35th. With regard to visible depreciation, it starts out at zero, and increases each year as time goes on. I assume that each

8152 year the depreciation is the same. You cannot figure that and say one year might take 1/36th, and the next year might take 1/34th, or use 2% one year and 4% the next. The sum of the functional depreciation and the physical depreciation must necessarily represent the total annual depreciation each year, but I have not attempted to assign any value to each. The visible depreciation is greater in the latter years of a structure than in the first; that is, more apparent. The functional depreciation is not in evidence until it happens—it is the action of an instant.

8153 There is more physical depreciation at the end of six years than there was at the end of four, but there is not more physical depreciation in the latter years of a structure, such as a flume, than there is in the earlier years. You are getting a cumulative effect; you have gotten a weakening of all the members, you might say, but it is there as a percentage only. The depreciation in a flume seems to be greater in the last five years than it is in the first five, but the first five had to pass to bring about the condition of the last five, and to try and get into that refinement leads you nowhere. I am taking the structures, and I am trying to figure the bricks in the layers; we may figure that the topmost layer has so much less to carry, but the wise man will widen his footings and say, here I am not going to get any unit of pressure in excess of a certain predetermined amount; you are in the same fix in trying to differentiate.

8154 In the matter of the flume, there seems to be more evidence of the depreciation in the last years than in the first years, but whether it is or not, I cannot admit that. I have seen pipe that has decayed, and flumes and timbers that have rotted, houses that have gone out, but to state that these things between such periods went faster than at other periods, I don't know as anyone has made any measurements of that; for instance, you can paint timber up to a certain time, but when it gets too badly rotted away you cannot paint it, as the paint won't hold on to it; yet the last condition is the result of the working of all the time that has elapsed previous to that, and it seems that it is rotting away faster in the last years, but I think appearance is deceptive, that although the rotting away would seemingly be faster in the latter years, that it had all to be present and be acting in the earlier years before the condition that confronts structures in the last years was possible; they are all
8155 links in the chain.

Dillman

Witness: Geo. L. Dillman for Defendants.

CROSS EXAMINATION BY MR. GREENE.

I did not depreciate the value of any of the water company's dams because of the silting up of reservoirs. The silting does not

amount to anything, and I have not taken it into consideration. My depreciation allowance is fundamentally an accounting allowance rather than one resulting from an inspection of the structures, but I think that the condition of the structures should be taken into consideration in fixing that allowance where they can be. I do not think that if two appraisements are made, one of which does take into consideration that fact, and the other of which does not, that one is entitled to more consideration than the other. The depreciation from an examination will be a very variable amount; it will vary with every man that makes the examination; it will vary with two examinations made by the same man, and while it has some value, it will result in very peculiar conclusions. It is very apt to result in an appraisal of structures only a short time apart as showing an actual appreciation, and lessening of accrued depreciation, by attempting it. I believe in inspection, and think it is very important, 8156
and should be taken into consideration on deciding on the life of a structure. I made an inspection, myself. I used it in fixing my time of life, and to the extent I have used it in the other way, which is only to a small percentage of the structures, and probably insignificant. I really think that my estimates should be revised. By the time of life, I mean the probable life.

Referring to the Pilarcitos Dam, which I estimated would cost $198,000 to reproduce in December, 1913; if that dam had been reconstructed in 1913 along the lines that I had in mind, it would have been the same dam as is there now as a physical structure. If it had been constructed in 1913, I would have made no allowance at all for depreciation in my valuation in this case. 8157

The structure in use has practically 100% of its original value. The only reason for considering a depreciation is to give weight to the idea that it is not reasonable to consider that any structure having known lines of depreciation functionally, otherwise would last more than 200 years. If it had been a matter of rates alone that I was considering, I don't know whether I should have depreciated it; at the same time, whatever the depreciation is, it is allowed on the other side of the column in the depreciation allowance, and the straight-line method of depreciation was used. The 23% results from 46 years life, and to the extent the assumptions are wrong, the results are wrong.

My work started as a value for condemnation. If I had the rates alone to consider, I should have used the reproduction method, and not considered any allowance of depreciation. I would not have any depreciation at all. If I were not considering condemnation proceedings, I would just consider it as capital account; the depreciation is a fact, but unknown, and the depreciation allowance is a payment made by the rate-payers to cover the whole value of the structure during its life, and therefore I say that depreciation is sim-

ply one way of making the account. I do not think the physical
8158 depreciation, or the functional depreciation of Pilarcitos is 23%; I do not think the combined depreciation is 23%, but I do think that in consideration of an assumed life, which is in itself subject to revision and discussion, that this 23% should be deducted on account of the 46 years of life, and at the end of 200 years of life the company will have been reimbursed for that structure; it is no very serious matter to the rate-payers; the company might as well have the benefit of that money, and it might last 500 years. I have not assumed that anything would last over 200 years, but with that assumption of a 200 years life, and 46 years of age, straight-line depreciation points directly to 23%. In a rate case alone, I would simply get the same ultimate results as to returns in a little more direct and simple method. I would simply return a rate based on the full value which was slightly in excess of ordinary interest rates, plus the operation and maintenance expenses to the company. In other words, I would figure my return on reproduction costs undepreciated.

8159 Functional depreciation is an element of the future. It is not anything that can be reckoned by direct computation. I know the Pilarcitos country, and with the advent of Sierra Nevada water, it is perfectly possible that Pilarcitos water will not be brought this way, and that is one thing which convinces me that Pilarcitos has a limited life, although there is no sign of that limit. I think there is some hazard in the future as to the possible continuous operation of the system, and I put that into figures by considering that its life is 200 years.

Your supposition that the Pilarcitos Dam was built when it was, 46 years ago, and the San Andres Dam was a duplication of it, and was built 50 years later, with the question to me of whether it would be fair, or would represent the fact to depreciate one of those structures 23%, and the other 2%, purely from the point of view of func-
8160 tional depreciation, simply brings into review my assumption that a structure of that kind ought to be depreciated 100% in 200 years; if that is wrong, of course the result will be wrong, but whatever the error is as to actual depreciation, it is partly, if not wholly, made up for by the annual depreciation allowance which results from that same assumption.

The Davis Tunnel, prior to the construction of the Lower Crystal Springs Dam, diverted water from San Mateo Creek to San Andres, which can now be diverted in two other ways into San Andres, and if it is not diverted in either of those three ways, it will be captured in Crystal Springs; therefore, its purtenance to the job, its duty in the machinery of the waterworks, is small in comparison with its use when it started; it has depreciated in use, but not in physical depreciation. That is why I depreciated it 80%.

Mr. Dockweiler: The Davis Tunnel was built to divert the water of the upper reaches of the San Mateo Creek into the San Andres Reservoir. That tunnel is not necessary now, because the water can be caught at one of the two dams at the dam where the Pilarcitos pipe line crosses San Mateo Creek it can be diverted into that tunnel, and be sent into the San Andres Reservoir; then it can be sent into San Andres by the Stone Aqueduct Conduit, the water being diverted by the San Mateo concrete Dam No. 2, and sent through that tunnel into the San Andres, so the company has two whacks at that same water. 8161

Mr. Dillman: Whatever the reason for its construction, and whenever it was built, it would not be built today with a remodeling of the plant.

Mr. Metcalf: I gave it a nominal rate. That is, I considered it practically an unlimited life. 8162

I think what Mr. Dockweiler says is true, that you can divert at either of the other points. You get some advantage, but I don't know how material it is, from the fact that the added capacity of that tunnel enables you to put a little more storm water through that would perhaps go down and get into Crystal Springs. It may result in your actually getting a little more of the water into the high service of San Andres.

Mr. Searls: Do you think the tunnel, in view of that situation, would have the full value of other tunnels in use which are absolutely necessary would have?

Mr. Metcalf: If you mean by that that I think that if the plant was being built de novo, that is, at the present time, would three tunnels be built; I think very likely they might not, that is, the company is facing a different situation today from what it faced at the time of the construction of these several tunnels.

Mr. Hazen: I did not give any depreciation to the Davis Tunnel at all. I did this with the Davis Tunnel, and the other tunnels which 8163
Mr. Dillman has mentioned; I separated out from the various places in the inventory where they were all the structures that carried water to San Andres by gravity that would otherwise go to Crystal Springs, in Table 4, and considered the question of whether those structures in the aggregate were reasonable for that use. These structures do not add anything to the supply of the company. Every one of them could be obliterated, and all the water could be available; but they do mean that a certain large quantity of water is available at San Andres instead of at Crystal Springs, with the exception of the last three items, which go with the pumping station and the flume, all the rest of it, amounting to $567,000, could be wiped out, and the water could be pumped from Crystal Springs to San Andres. I don't mean that the Pilarcitos and the Stone Dam structures would not be useful. In my Table No. 4, Exhibit 97, I separated the structures along those lines,

instead of along the lines in the inventory, because I wanted that information. You will find in Table No. 2 the structures for carrying Pilarcitos water to the Crystal Springs Catchment Area. If those structures were obliterated, the Pilarcitos water and the Stone Dam water would go to the Pacific Ocean and be lost, so they are necessary to save the water. Now the $567,000 worth of structures in Table 4, excluding the last three items, save pumping, and the cost of pumping water from Crystal Springs into San Andres, would be a good deal more than the return on this $567,000. Some of the water, as far as
8164 the Davis Tunnel is concerned, would go to San Andres by either of the other two ways without pumping, but not all of it would go, because of the capacity.

CROSS EXAMINATION BY MR. GREENE.

Mr. Dillman: I depreciated the Lake Honda Reservoir 80% because it is an old reservoir, and it is along the earthquake fault, and it is valuable property for residential purposes which makes it more liable to go out of use. Therefore, I have shortened the life of it on that account. The more valuable it became as real estate, the more
8165 liable it is to go out of use, and the shorter its life. I don't know how long that has been used. It was built before Schussler's time by Von Schmidt. I gave it a life of 100 years.

For the main reservoir on College Hill, I depreciated that 21%, and gave it a 200 years life. I suppose it is 42 years old. I cannot say that that is all functional depreciation in those two reservoirs. I suppose College Hill would be used forever, but from a consideration of this 200 years assumed life, and the 42 years of age today, it results in that 21%. It is the same basis that I used for the dam. The functional depreciation is considered just in the estimated life of the structure; that is where it is put into figures. There is no allowance to be made for physical depreciation in that part of it; there are other parts of College Hill structures that depreciate more. For instance, I have given some of the wooden fences and gates a different figure, 20 years of life, and 50% of depreciation.

University Mound I have considered as having a 200 year life, and 14% depreciation. Taking the reservoirs as they stand, I do not
8166 think there is any essential difference in condition between University Mound and College Hill as far as depreciation is concerned. That is, not of the main reservoirs; some of the auxiliary structures are different. Those small distributing reservoirs have great value to the distributing system, and even should they silt up, they would be cleaned out on a maintenance charge at a very reasonable expense.

I have depreciated the city distribution system 47%, and that figure is reached in the same way. I think that 40% is probably for riveted pipe in District No.1. I have estimated it as 60 years of life, and 28 years old. I did not make any examination of that pipe. It is

all underground so far as I know. I made an allowance for depreciation on the cast-iron pipe in District No. 1 in the city 27%; District No. 2 in the city 23%; District No. 3 in the city 18%, corresponding to 100 years estimated life, and 27, 23 and 18 years of age. I did not make any examination as to the physical condition of that pipe. It is all underground.

Questioned by Mr. Searls.

I saw some cast-iron pipe in the yards, and it is in good condition. I don't know that it will play out in 100 years; I think some of it will be in use for more than 100 years, maybe most of it. The small pipe will probably be replaced. 8167

CROSS EXAMINATION BY MR. GREENE.

Depreciation in this case is not from a lessening of use, but it is from a known fact that a great many of these structures will go out, and the assumed fact that the large reservoirs will be abandoned for some reason in 200 years, and the cast-iron pipe in 100 years. I consider that 39%, roughly, of the total cost of the structures is a reasonable allowance in a property of this kind, and in the condition that this property now is in.

I don't think that depreciation increases as the life of an ordinary waterworks structure increases annually. I think these curve line depreciations are more for getting a uniform accounting to mark off, than for any actual facts of depreciation. While it is true that a flume is considerably stronger at the first years of its life, and needs less maintenance, and that it requires greater maintenance in the last years of its life, until it reaches such a point that the maintenance is so onerous that it demands renewal, I see no reason to believe that the actual depreciation is along the curve-line at all.

ONE HUNDRED AND TWELFTH HEARING. MARCH 8, 1916.

Witness: C. E. Grunsky for Plaintiff. Grunsky

CROSS EXAMINATION BY MR. SEARLS. 8170

Referring to my map, "Plaintiff's Exhibit 158"; in making my study of the indicated costs of reservoir lands of the Crystal Springs, I selected as examples of the watershed lands Parcels 39, 90, 48 and 49, as shown by my table. There was no particular reason for leaving out Parcels 73 and 72. I used these four tracts, 39, 90, 48 and 49, as tracts, 8171
two of which are near the northerly end of the reservoir, and two near the southerly end, and in each of these tracts the watershed area is very much in excess of the reservoir area, and therefore, as a first indi-

cation of the amount that was probably paid for the watershed lands, these four tracts serve the purpose.

I also left out Tract 41, which is on the west side of the reservoir near the north end, and I also left out Tract 42, which is on the Crystal Springs watershed. This latter tract was a small tract of land, and it did not give a very clear idea of what watershed lands would be worth in that vicinity, in view of the very large other tracts that were under consideration in getting a first idea of cost. I think there is no question but in 1874, $175 an acre was paid for Tract 42. If $175 per acre
8172 was paid for Tract 42, and $133 for Tract 41, that would be some indication to me of the price that was paid for small tracts of watershed lands at that time. Parcel 39, which I have used as an example of watershed lands, outweighs in the average all of the other parcels which I have used, because of its great acreage. I am familiar with the topography of that country, and Parcel 39 extends up to the summit of Sawyer Ridge. That parcel contains a great deal of the rough land that is on the Crystal Springs watershed, and it contains very much more of it than any of the other parcels that I have considered in this connection; it is a very much larger tract than any of the others.

8173 I was endeavoring to determine what the difference in the cost price was as between the valuable valley land within the reservoir area, and the land of the character of the watershed, some of which is very rough and broken. I should say that land of the character that is contained in 39 could be compared in this way with valley land, that is, to find out what the difference in value is, or what amount was paid for it, but I do not wish to say that the very rough watershed land was as valuable as level tracts of land within that watershed. If this valley had been totally unavailable as a reservoir site, the distinction in value may have existed, though perhaps not quite in the same degree. I can readily conceive the land within the valley of what is now Crystal Springs Reservoir being sold at from 5 to 10 times as much as the adjacent rough land which is not in the valley, or not in close connection with the valley. I don't believe that I gave any consideration to the Mills-Easton land which lies between Parcels 73 and
8174 42 in this study as to the relative price paid for the selected tracts which were enumerated in my tables. The Mills-Easton Tract would probably be of the same general character as Tract 42, although it extends up on the west side of the valley more. If the Mills-Easton Tract had been acquired in 1874, or at any time between that and 1886, it would probably be in some relation to these amounts on Tracts 42 and 73, but, of course, I don't know what the cost of the Mills-Easton Tract was.

Referring to Parcel 41—reservoir land—the relative areas of reservoir and watershed lands, based on Mr. Sharon's figures, are 5.6% of reservoir lands, as against 94.6% of watershed lands. I think that

was selected as a reservoir parcel principally for the reason of the 8175
large per-acre price that was paid for land in that vicinity. That might just as well have been omitted from this table that is given in my statement on page 4. I selected mainly tracts that had reservoir lands in fairly large area for indicating the reservoir land. Parcel 41 might just as well have been omitted from that statement. I think it was really left in there by inadvertance. At the time I made these figures I was attempting to fix in my own mind about what the costs of reservoir lands was at the time the purchases were made; so I was interested in the large per-acre cost, or in those tracts in which the per-acre cost was high.

Parcel No. 94 was the Drinkhouse purchase, and it is nearly all in the reservoir; there is just a little marginal strip that is out of it.
I was employed some years after 1886 to appraise this Drinkhouse 8176
land, and the value that I placed on it at the time that I testified in the Drinkhouse case, according to my recollection, was $1,250 per acre. In that case I testified for the owner of the land. When I became City Engineer I think I used the same figure in the report that I made to the Board of Works in 1901 for that tract. That report, I think, was introduced in evidence in the last Spring Valley case practically as a
whole. I am not familiar with the improvements that were on that 8177
Drinkhouse land at the time it was bought—referring to Tract 94.

Mr. Searls: In the decision of the Drinkhouse case that was reversed by the Supreme Court, the trial court found that the value of the land and improvements was $4,667.50; that the damage by severance was $435.50; that the costs to be allowed the defendant were $100; that made a total of $5,203, or $362 per acre. Taking the testimony of all the witnesses from the record in that case, they show an average record of $2,000 for improvements. The case was appealed to the Supreme Court by Mr. Drinkhouse, and the Supreme Court reversed the case on the ground that the trial court had excluded any consideration of reservoir values, and had also refused to permit Mrs. Drinkhouse to give her opinion of the value of the property. The case was sent back for trial in the court below, and the company made a deposit in court of an additional $5,000 to cover damages under the section
of the Code of Civil Procedure, which permits them to take possession 8178
of the property upon making such a deposit. Then Mrs. Drinkhouse applied again to the Supreme Court for a writ of restitution, and the Supreme Court denied the writ. The first case in the Supreme Court is reported in 92 Cal. and the second in 94 Cal. The history ends there, as far as anything we have been able to find about the ultimate disposition of the $5,000 that was deposited in court was concerned. The company has charged that up to the purchase price of the land.

Mr. Olney: Whatever was paid into court in order to keep the property in the meantime, under the section of the Code, would naturally be applied on the purchase price when the final time came.

This figure of cost must be the figure that the company finally had to pay.

CROSS EXAMINATION BY MR. SEARLS.

Mr. Grunsky: I understood at the time that the record in this
8179 case shows that there were improvements of some value on this property. I did not make any deduction for those in estimating my peracreage value, because I was simply interested in what it cost the Spring Valley Water Co. to acquire the land, regardless of whether there were improvements on it or not.

I made no inquiry to ascertain whether Parcels 39 and 90, and the other watershed acreage parcels that I used contained any improvements, but I presume they did. I think that was the case with reference to 39, although I am not informed at all, and I did not make any inquiry about it. If there were improvements on Parcel 39, they would bear a very much smaller proportion to the total cost of the parcel than the improvements on Parcel 94 would bear to the total cost of that parcel, because the cost price of 94 was about $10,000, or a little more, and the cost price of 39 was nearly $39,000, so that the same amount of improvement would affect the average per acre less in the case of 39 than in the case of 94.

I was not familiar with the Sherwood place—Parcel 92—as far
8180 as its boundaries are concerned prior to the time the dam was built. I didn't know the tract as the Sherwood Tract, nor had I been on it so far as I know. I have a recollection that it was a very beautiful country home. I was at the site of the dam in 1886 and 1887, and I was there again at the time that the dam was about half completed. I had a very favorable impression of that locality, although I did not know the locality sufficiently to identify the particular tracts.

There were a number of country homes in the Crystal Springs Valley, and there were the improvements in the valley that had been made by the San Mateo Water Co. There was farm use made of the valley, but I cannot give that in detail, as I have not any notes to refer to as to just what that situation was at the time I was there, and it is not clearly impressed upon my mind now. I was there at the time the surveys were being made by Mr. Allardt, who had a contract for making a topographical survey of the Crystal Springs. The work was in direct charge of Mr. C. H. Kluegel, who was my superior when I first commenced engineering work. I spent a day with Mr. Kluegel, who
8181 was then residing at the dam, which was then in the course of construction. I got a fair impression of the valley, and of the situation there, but I did not make a critical examination of the entire valley. It is my recollection that there was a hotel, known as the Crystal Springs Hotel. I do not recall what parcel that was on.

The total acreage of 87.64 acres, which was shown by the Spring Valley deed to this Parcel 92, as compared with the 80 acres which the

tract was afterwards found to actually contain, would make the difference between \$406, which I have shown as the actual cost price, and \$371, which may have been the price per acre the parties thought they were getting at the time they made the sale. There is about 60% of 8182
that tract in the reservoir.

I have no recollection as to whether there were any improvements on the Carey Place, Parcel 96. It was a small tract, containing about 24 acres, with about one-half of it in the reservoir. I do not recall whether there were any improvements on Tract 47, which was just at the point where the Upper Crystal Springs Dam is located. I don't recall the appearance of the country near the dam there. I mean by that, at the time of the purchase in 1875, or at the time I saw it in 1876. 8183

In Parcel 68, which was the San Mateo Water Works purchase, I include all the sub-divisions or acreages in my table where used. The San Mateo Water Works property included some small reservoirs that I cannot describe at this time. In 1883, when that purchase was made, the upper dam of the Crystal Springs had already been constructed, and there was a reservoir there at that time.

(It was here found that there was a misunderstanding on the part 8184
of the witness, who thought that Counsel for Defendants was referring to the south end of the lake, whereas, he was in fact referring to the north end of the lake, and that there didn't seem to be anything marked 68 in that locality).

There is a little tract in the middle of the reservoir which is included in my acreages, and I remember there was a reservoir in that vicinity, but I do not recall any details in reference to it. That is to the northwest of the present Lower Crystal Springs Dam.

Taking my total acreages, and basing my percentage on Mr. Sharon's figures as to reservoir and watershed acreages, there was only 15.3% of the San Mateo Water Works purchase which lies within the Crystal Springs Reservoir. In that case, the Spring Valley Water Co. 8185
moved the San Mateo Water Works down to the present screen tank lot, and supplied the water they had always used from the Crystal Springs Reservoir; they were under obligations to deliver 300,000 gallons a day.

The selection of tracts indicated on page 4 of my statement was 8186
made for the purpose of getting an idea of the amount per acre that was paid for lands having a considerable amount of reservoir area, and determining what the proper relation would be between the cost of the reservoir lands and the watershed lands. I therefore made a selection of the tracts of land for which the highest price per acre had been paid that contained fair amounts as reservoir land, in getting my first idea of what reservoir lands cost; taking those tracts of land in which the watershed predominated, for getting some idea as to what watershed lands cost, I did the same thing. Then if the cost at the time these purchases were all made was any indication of value, some conclusion

could be drawn from that fact. I selected only those tracts for which a high price was paid, because they gave an idea of the amount that was being paid under certain circumstances for reservoir lands.

I could find nothing in Tract 37 at $30 per acre that would indicate cost of the reservoir land. The cost of the reservoir land in that tract was probably very much higher than the cost of watershed land, but there was no segregation made at the time of the purchase. If you will turn to my Table No. 19, the 10 to 1 ratio would indicate that $77,
8187 or about that amount, was paid for the reservoir land, and about $7.70 for the watershed land, and that is based on a pure assumption. It is correct, in a way, to say that I have sought to prove my assumption by taking the original costs of land which was presumably reservoir land, and comparing them with the original cost of land which was presumably watershed land. It is certainly evident that in some cases purchases may have been made at more than market value; in other cases purchases may have been made at much less than market value; the average price in the case of this particular tract, 37, was $30 per acre. The probability is that less was paid per acre for that land, both in the watershed area and in the reservoir area, than the average that was paid for the entire Crystal Springs, reservoir and watershed, because if you add all the purchase prices together, and the total area, and then divide, you will find that the average will be higher than $30. Tract 37 was used in the final analysis, but in getting my first idea of what was the probable cost of the reservoir land as compared with the probable cost of the watershed land, it was not used. My final analysis amounts to nothing more than a segregation, according to my assumed indication of 10 to 1, but I find that assumed indication to be about
8188 correct, or rather, less than what actually existed in the vicinity of Crystal Springs as shown on this statement I have prepared. I don't think there is any question about the accuracy of that result. The thing that shows it, if it shows it at all, is the fact that the average price paid for lands which were largely in the reservoir was ten times the average price paid for lands which were largely watershed.

In the ultimate analysis I drew the line between the lands that I put in the reservoir category, and the lands that I put in the watershed category. In getting my starting point, I did not use Tract 37, for the reason explained. I used the selected tracts, which included No. 68, to find out about what the amount was that was paid for considerable areas of reservoir lands. I found four or five tracts in which these amounts per acre were from $200 to $700. Then I did the same with reference to the watershed.

It is substantially correct to say that wherever I found a high price paid for land, I assumed that it was paid because part of the land was in the reservoir, and wherever I found a low price paid, I assumed it was low because it was watershed land, and as I say, it is substantially correct to say that, because that was what was done in

making those purchases. Where a tract of land included reservoir land, 8189
there were higher prices paid than when the land was watershed. I am not sure whether Tract 37 bears out that contention or not. The probability is there was more paid for the land in the reservoir than for the land that was outside of it; there was no segregation made at the time of the purchase, and therefore we have no positive evidence with reference to that, and we can only conjecture as to what might have been the cost price of the reservoir land, and of the watershed land, taken separately.

I did make such an assumption with regard to Parcel 68, and it appears in Table 19. The use I made of Tract 68 in the first place was simply to assist me in getting a starting point. You will find that in Table 19, Tract 68, on the basis of 10 to 1 ratio, shows $1700 per acre for reservoir land, and $170 per acre for watershed. I think probably that more was paid in the acquisition of that tract per acre, both for watershed and reservoir land, than market value of lands at that time, but that was the price paid, and that goes in to make the ultimate average. I think these improvements in the shape of artificial reservoirs were all in that part of the tract which I would class as reservoir land in the Crystal Springs.

Tract 44, that contains that little island in the southern part of the lake, I did not include in the reservoir category; that is, in getting my first impression of reservoir land costs; it was not included in that 8190
list that is given on page 4 of my statement. I did not use Parcel 55 down at the southerly end of the lake in getting my first impression of per-acre cost. I did not include Parcel 50, bought in 1875, but I do not wish to be understood as saying that they were at all ignored in reaching a conclusion as to what the probable average price paid for reservoir lands was. After I ascertained about what amounts were being paid for reservoir land, and what amount was being paid for watershed land, and constructed Table 19, I reached the conclusion that in the cost of the Crystal Springs Reservoir, and its adjacent watershed, that at least 10 times as much was paid for reservoir land as was paid for watershed land. The segregation is given for each particular tract in this table, although the segregation applies to the 8191
totals given in the last line. The average price paid for Parcels 37, 44, 55 and 50 simply goes into the final result that appears in the last line of the table. Every one of the tracts, the average prices of which I have used as a basis for getting my indicated cost of reservoir land, with the single exception of the San Mateo Water Works purchase, was under 100 acres in area, and all of the tracts which I have used as a basis for getting the indicated cost of the watershed land, were comparatively large areas of over 400 acres, I think, everyone of them. It is possible that these small tracts under 100 acres in area were for the most part used as homesites. It seems probable to me that they were so used. I think it would cost the company more, leaving all consid- 8191½

eration of reservoir lands out, to buy lands of that sort per acre than it would to purchase large tracts of land such as is classed in Tract 39, assuming that the Crystal Springs Valley was utterly unadaptable as a reservoir site.

8192 Parcel 130, consisting of 390 acres, is all in the San Andres watershed. I did make a distinction between land in the San Andres watershed, and land that is in some other watershed, in comparing my reservoir costs with my watershed costs. The fact that Mr. Sharon's segregation shows that only 42½% of this parcel is in the San Andres watershed, and the rest is on the other side, and on top of Sawyer Ridge, draining into San Mateo Creek, would not make any difference in my apportionment. It simply indicates that the average amount of $15.38 was paid for that character of land which was on that ridge, and extending down upon both sides of the ridge. There was no distinction made as to the cost of the watershed. I was simply using that tract as an index of about what was being paid for lands of that character.

8193 Tract 13 was not classified as watershed land, but the price paid for that land, of $24.40, was used as indicating an upper limit of what was paid for watershed lands; the average price having been $24.44, the probability is that if the watershed had been acquired by itself apart from the reservoir, the average price paid for that land would have been less than that amount. That was purchased in 1868. Parcel 43, purchased in 1874, cost $5 an acre more than Parcel 13. I would not attribute that difference entirely to the difference in time of purchase. Parcel 43 helps to show what watershed land cost at that time.

Tract 14, purchased in 1868, has 25% in the reservoir, and cost
8194 $27 an acre, which is less than Tract 43 cost six years later. Tract 15 was acquired in 1868, and was the only tract of land on the east side of the reservoir which has a large excess of watershed over reservoir area. The average cost of that was $70 an acre, with only 7% in the reservoir. The land that was above the reservoir, on the east side of San Andres Reservoir, at the time that Tract 15 was purchased, cost somewhat less than $70 per acre. I think anyone would conclude that, just from the fact that only a small portion of that tract was in the reservoir, the reservoir land would, undoubtedly, if it were purchased separately, and as reservoir land, have cost more than the average price; consequently the remainder of the land of the watershed area would cost somewhat less than $70 an acre.

The average cost of Parcels 16 to 21 was a trifle less than $120; one parcel is a little below $120, the average cost, and that was Parcel 18, the average per-acre cost of which was $91.95.

8195 Parcel 51, purchased in 1876, at $80 per acre, was a small tract, and it would not have given me any particular indication of the general value of land outside of the reservoir, and it would have

been of no particular help to me in getting my first approximation of the cost of watershed lands. Furthermore, it is valley land just at the upper end of the reservoir. So far as reservoir and watershed values are concerned, it does not make any difference to me whether it is valley land or hillside land. I was endeavoring to get an idea of the approximate cost of the watershed lands, in order that I might segregate the amount paid in each particular case between the reservoir land purchases and watershed land purchases. Parcel 42, like Parcel 51, would have been of no particular aid in making my first approximation of the cost of watershed lands, because it was a small parcel.

In the Pilarcitos I have an average cost on Parcel 5-2, of $5.48 an acre, and Parcel 5-1, with only 3.3 acres, or 10% of its area in the reservoir, cost $24.92. Then I have Parcel 106, with an average cost of $10 an acre, and only 24 acres, or 7½% of the area, in the reservoir.

I gave consideration to the fact that if I assume the watershed cost was the same as the average cost on Pilarcitos of $4.85, that would make my reservoir cost 40 times that, when I came to apply 8196
my theory to Parcel 5-1. In the first place, Tract 106 was purchased in 1889, and the other tract was purchased in 1866. In the second place, it is quite possible that the per-acre cost of watershed, as well as reservoir area, was larger in the case of 106 than in the case of 5-2. There is one reason why I endeavored to obtain some ratio that would enable me to approximate in the aggregate about how to apportion total cost to watershed and to reservoir lands. If I should determine a price paid for the watershed as the average, and then apply that to each individual tract that contained both reservoir and watershed, it would lead to absurd results in some cases, just as in the case of 106. That is quite possible when you apply watershed values, no matter how determined, to all the individual tracts.

I did not intend to segregate the watershed lands according to any percentage, and I think that 5-2 gives a fair indication of the 8197
price that was actually paid for watershed lands. In speaking particularly of Pilarcitos, I thought I made it clear in my statement that the ratio of 10 to 1 would fit as well as any other, but that there was not any clear indication of what the ratio might have been in the case, as explaining how I get an indication out of these lands purchased as to what price was paid for reservoir lands. That does not apply to the segregation when all the three reservoirs are taken collectively. I used the figures of Messrs. Baldwin & Hoag on the watershed lands in checking my apportionment of figures, to see where that would lead. I have no means of knowing what their conclusion would have been if they had included the reservoir lands in their appraisal.

In considering the weight to be given individual parcels in all
8198 three of these reservoirs in making up my averages, I did not take into account my assumed appreciation of land per year. That had nothing to do with this segregation. It was simply made for the purpose of determining prices paid for the land. Wherever I have used the percentage of 4½% or 5%, I mean that it should be compounded every year. I based that assumption of percentage on a study of increase in values that has occurred in the vicinity of San Francisco Bay, and that was the study I presented in my first testimony. If simple interest is referred to in connection with increase in land value, some term has to be named, as for instance, 10 years, at which you begin anew and apply your simple interest. If that is not done, it will be equivalent in the course of say 30 or 40 years to basing your annual increase in value upon a percentage that is applied to a value that existed 30 or 40 years ago. In obtaining that estimate of increase for San Mateo County, I made a study of increases in the land value that related to the entire county, so that it included everything.

Questioned by Mr. Greene.

If periods are under consideration of 30 or 40 years, and simple interest were figured, based upon an original value of $100, we will
8199 say, at any assumed interest, as for example 5%, the increase by simple interest would be 150% in 30 years; if some period was selected, as for example, 10 years, at which a new start were made, and the interest was then applied, the result would be several times greater in the course of 30 years or 40 years.

CROSS EXAMINATION BY MR. SEARLS.

I understood that there was some public land in San Mateo County in 1868, and the early seventies, but not very much. That would not be subject to assessment until it finally passed into private ownership. In considering the total assessed value as a basis for estimating my annual increased percentage, I have taken into account some new land, coming on to the assessment roll in that way. It would be trifling in amount, and would not affect the result any.

8200 RE-DIRECT EXAMINATION BY MR. GREENE.

I didn't consider the improvements in my consideration of costs, because what I was after was the price that was paid per acre for the reservoir land, and it made no difference what the purchase included in the matter of improvements upon the land; it resulted in the acquisition of a certain number of acres of reservoir lands, and what I was interested in was the price paid per acre for that land in a condition ready for use in the reservoir.

The figure of $42.10, Table 19, which is my average on a 10 to 1 basis for the watershed lands, would give a slightly smaller amount

than the average of the figures given by Mr. Baldwin and Mr. Hoag, if interest is added at the rate that I have suggested as proper; if a 5% increase in value annually is assumed, we would have to start with $45.30 per acre to reach the appraisal as found by Baldwin and Hoag.

The figures concerning which inquiry was made this morning, by Mr. Searls, related to figures that were used by me as a first approximation of the cost of the watershed and the reservoir lands, and particularly the cost of the watershed, because I wanted to know the cost of the watershed in the case of those tracts of land which contained a considerable area of reservoir land, and then finally determine about how in the aggregate the apportionment should be 8201
made. Taking the Crystal Springs Reservoir as an illustration, upon inspection, it appeared that the first approximation to the cost of the reservoir land would be about $400 per acre, and that the average price that had been paid for watershed lands, taking those tracts which are enumerated in my Table No. 1, was about $50 per acre, and that indicated that the average ratio that I developed was about 8 to 1; that was the first approximation; then by using that ratio, and taking Tracts 39, 90, 48 and 49, a closer approximation could be made of cost of reservoir lands, and by that system of gradual approximation, I reached the conclusion that the average cost per acre of the watershed lands in the selected tracts at the Crystal Springs Reservoir was about $27 per acre. I think that appears fully in the statement which I made under direct examination. If I had used $27 per acre instead of $42.10 per acre, the cost that would have been estimated for reservoir lands would have exceeded $421.

Questioned by Mr. Olney.

I was endeavoring to find out about what watershed lands, as such, cost the company away back in the years when these particular tracts were purchased, and I did that by taking certain tracts which were made up most largely of watershed lands, and ascertaining the actual average value per acre that was paid for the lands included in those tracts. Assuming that $50 per acre was the actual cost of these lands, made up most largely of watershed lands, I concluded 8202
from that that the actual average cost of the watershed lands by themselves, which were included in these particular tracts, would be something less than that. I do not know how much less, particularly, but where I have made the assumption of $50 an acre for all the land in the tracts, both reservoir and watershed, I would say, purely as an assumption, that most of the land being watershed, that the average price of the watershed lands alone would be $40 an acre. In the same manner I took tracts of land made up chiefly of reservoir land, and got the actual average price per acre that was paid for those lands. Then I concluded that in-as-much as there was in those

tracts of land some watershed land, that the price paid for the reservoir lands would be somewhat higher, how much, exactly, I did not know, than the average price that I got for those tracts. Then with those figures I tested my proportions of 2 to 1, 3 to 1, 5 to 1, and 10 to 1, with this intermediate step, that the price paid for the watershed land was used in making a closer approximation of the cost of the reservoir lands, in those tracts which contained both reservoir and watershed, and particularly in those tracts which contained a large proportion of reservoir lands.

I used the figure which I got at in this method concerning the average price of watershed lands in getting the price paid for the
8203 reservoir lands, because if the watershed cost is approximate, even if it is somewhat in error, and a tract is under consideration that contains considerable reservoir land, a closer approximation can be made of the cost of that reservoir land by using that watershed cost, than if we simply took the average.

In order to get at the average cost of watershed lands, I have not included in this list all watershed tracts made up largely of watershed lands, and that was done intentionally. I simply wanted to get from certain purchases, that were apparently best indicators of what watershed land cost, an approximation of the cost of watershed lands, and it was not necessary for that purpose to give consideration to all of the tracts. Then when I reached the conclusion that the ratio of about 10 to 1 was sufficiently close to enable me to segregate the amount of money that was paid in the aggregate for reservoir land, and in the aggregate for watershed land, then all tracts that appear in the table entered into the calculation.

Questioned by Mr. Searls.

As to my basis of selection of those tracts: In the first place,
8204 the relative amount in reservoir and in the watershed, that is, without using any definite percentage, but simply a tract that contained a large amount of watershed land might be used as indicating fairly well what the price paid for watershed land was, or in the reverse case, a tract which was in the heart of the reservoir, and contained a large amount of reservoir land, even if it did not outweigh in acres the amount of watershed land, could serve as an index of the price that was paid for reservoir lands. In other words, what the market value of the reservoir lands was at the time that these tracts were purchased; it gave some indication of that fact. Throughout this whole study I was endeavoring to find those facts which would bear upon the market value in one way or another, and the object of this segregation of the amount paid for the lands into the amounts paid for the reservoirs and for the watershed, became necessary, because I was giving consideration only to the reservoir lands. In the case of the Crystal Springs, I made my selection in this way: I took two tracts that were large in the matter of watershed area

at the northerly end of the reservoir, and two tracts at the southerly end, to give me a starting point. I did not consider the result conclusive, but I simply used that as a first approximation.

Questioned by Mr. Greene.

That represents actually what I did when I started in on this study of costs. Then I made this tabular exhibit of where a 10 to 1 8205
ratio would lead, a 5 to 1 would lead, a 3 to 1 would lead, and a 2 to 1, and I reached a conclusion that for the purpose of segregating costs, 10 to 1 was near enough.

Questioned by Mr. Olney.

If instead of limiting myself to 4 tracts, I had taken into consideration as a part of the same table other tracts of land largely made up of watershed lands, the ultimate conclusion would not have been modified, even if I had started out taking all the tracts that are listed at Crystal Springs, because they all contain some watershed; I would have had an average cost per acre of perhaps about \$120. That may apply to the entire purchases, but those that I have listed will amount to about \$110 per acre. If I had used \$110 per acre as the first approximation of cost of watershed lands, and had applied that to these tracts that contained considerable proportions of reservoir land, I would have had a first approximation of reservoir land value a little lower than I actually made; it would have been very much higher in the case of Tract 68, but it would have been lower in the case of all of those tracts where in Table 8206
19 the per-acre value of watershed is shown less than \$100.

Questioned by Mr. Searls.

It would have made the watershed a little higher in the case of 68, because the 10 to 1 ratio, for example, gives the watershed per-acre cost at \$170; if that had been assumed to have been the cost of watershed land, \$100 to \$110, I would have obtained from some of the purchases an approximation of the cost of the reservoir lands. Then using that cost of the reservoir land, I could have made a closer approximation in all of the tracts largely made up of watershed of the per-acre of watershed, and it would have ultimately led me to the same conclusion which I have reached that the average price actually paid for watershed in the vicinity of Crystal Springs was somewhere in the neighborhood of \$27 per acre.

RE-DIRECT EXAMINATION BY MR. OLNEY. 8207

If I had included in the list which I have on page 3 of my supplementary report the tracts 72 and 73, and the other tracts to which Mr. Searls called my attention, the effect upon the ratio as gotten at by means of those tables would have been very slight; for instance, if Tract No. 41 had been included, which is about 45 acres in area, and which has about 42 acres in the watershed, the average cost of which is \$133.48 per acre, it would only have changed the result

of the average cost per acre perhaps $1; it would have been a very small effect that that would have produced upon my first approximation of watershed costs. Tract 41 is not a tract that is of any significance in the matter of indicating what the probable cost of
8208 watershed in that vicinity was, at the time that this reservoir was constructed, or at the time that these lands were acquired, because it is a very small tract in relation to the entire purchase, and the cost, if it were included, together with the other tracts 39, 90, 48 and 49, would have modified the approximated per-acre cost by only about $1.

I did not follow to a final determination as to what my conclusion would be, the ratio as determined, by a consideration of the actual purchases at Crystal Springs, between the price paid for watershed lands, and the price paid for reservoir lands, but it is in the neighborhood of 18 to 1. That is, the reservoir land costs about 18 times as much as the watershed, based upon the analysis as far as it has been carried by me, but the matter of finding a ratio made very little difference. I want to modify that statement: Taking the lands in the neighborhood of Crystal Springs, and using a ratio of 10 to 1, the cost per acre of reservoir is $421; using a ratio of 18 to 1, which is more likely, the acre cost of reservoir lands would then be indicated at $490 per acre, or about 16% greater than shown.

8209 Questioned by Mr. Searls.

That 18 to 1 is indicated by an approximation of the cost that was paid for the watershed by direct analysis of individual tracts, and a direct analysis of individual reservoir tracts. Every tract that contains reservoir land, also contains some watershed. If the entire amount that was paid for watershed and reservoir of the tracts that are listed in Table 19 were apportioned on these two ratios that I have just mentioned, then the statement that I have made applies. The 18 to 1 would apportion the cost probably more nearly in accord with the facts than the ratio of 10 to 1, but if 18 to 1 were used at Crystal Springs, it would only change the probable cost of land at the Crystal Springs in the reservoir from $421 to $490; therefore, I say it does not make much difference whether that ratio is determined with great precision or not.

I made a calculation, including all the tracts which you mention, to see how that affected my indicated relation. That is, excluding from the reservoir the tracts which you suggested were more properly watershed land, and including in the reservoir the tracts which contained as much, at least, reservoir land as I have used in the
8210 minimum cases that I have selected. You will find that on page 6 of my statement, where, after making a first approximation of what was probably paid for watershed land, an estimate is made of the average cost per acre of all watershed lands included in the tracts

enumerated in Table 1. If Tracts 72 and 73 are included with Tracts 39, 90, 48 and 49, it would change the amount from $27 to $28 per acre.

RE-DIRECT EXAMINATION BY MR. OLNEY.

This consideration of costs for these various tracts of land was 8211
simply one of the elements that assisted me in forming my conclusion as to the value of the reservoir lands on December 31, 1913, and it was confirmatory of the conclusion; the costs, having been approximated at the time these lands were purchased, and assumed increase in land values being applied, indicated the values at the close of 1913 that were consistent with my conclusion. My conclusion was based, not upon this consideration, but upon all the various elements that would be considered by a purchaser in determining what the market value of such a property is, everything that in any way might affect market value.

RE-CROSS EXAMINATION BY MR. SEARLS.

The ratio which I find existing between the cost of watershed lands and the cost of reservoir lands in 1874 does not necessarily continue throughout all the advance in prices in real estate lands in 8212
San Mateo County. Assuming that reservoir lands had the increased value which I indicate at the date they were purchased, it would not necessarily follow that they still bear the same ratio to the watershed lands surrounding them, although the presumption is in its favor that it is substantially the same.

If you were to assume that at the time Lake Merced was purchased that that also was a basin which was to be filled with water, and that the land surrounding that bore a ratio of 10 to 1 on the reservoir purchases, and you followed that consistently to date on the basis of the Plaintiff's appraisal of these Lake Merced lands, it is possible that you would have a value running up to about $20,000 or $30,000 an acre for your reservoir lands.

The date at which the Crystal Springs lands were purchased was assumed at 1882, and I was using the rate of increase, the general rate which prevailed in the bay region, and in fact somewhat 8213
less than that general rate. I think I took for my starting point for the Crystal Springs land 1882. I studied the increase in a general way for this entire period covered. An increase of 4½% or 5% a year is reasonable for the bay region. That cannot be applied with any great certainty to any particular locality, but it indicates the increase that must be expected in the case of real estate values.

In making the approximation of the cost of reservoir lands, no consideration was given to the difference in dates of purchase, at the time this approximation was made, and there was no consideration as to the time when these purchases were made given on page

6, where these average rates determined are applied to all of the tracts in order to get an average, or a probable average cost of the watershed lands.

8214 The calculations with reference to the apportionment of cost to the reservoir and the watershed were all approximations. There was no claim made at any time that I could determine with precision how these costs could be apportioned.

Mr. Searls: I note that this San Mateo Waterworks parcel, for which the company paid, as is shown by a division of the total purchase price by the total acreage, $404.72 an acre, was purchased by the San Mateo Waterworks in 1874 at $75 an acre from James Burns. That statement appears in the sworn statement of Mr. Burns in the record of the San Mateo Waterworks case, at page 503.

8215 Questioned by Mr. Olney.

Mr. Grunsky: Taking the situation as it has actually existed with regard to these particular reservoirs, and considering them in view of their connection with the City of San Francisco, and all the other circumstances that should be taken into consideration, I should say that the proportion in value between the reservoir lands and the watershed lands, since the purchase of these properties, would just as likely increase as diminish. I don't see any reason why there should have been a change in one direction any more than in the other. I think that when the decision was rendered by Judge Farrington, there was a ratio of 10 to 1. When I made my appraisal as City Engineer of San Francisco, there was a somewhat larger ratio which I had in mind, although it was not used in the form of a ratio. Just simply taking the result and making a comparison, it would indicate a somewhat larger ratio.

ONE HUNDRED AND THIRTEENTH HEARING. MARCH 10, 1916.

Witnesses: W. B. Lawrence for Plaintiff.
N. Randall Ellis for Defendants.
Allen Hazen for Plaintiff.
C. E. Grunsky for Plaintiff.

Witness: W. B. Lawrence for Plaintiff.

8217 CROSS EXAMINATION BY MR. SEARLS.

Lawrence "Amended exhibit, miscellaneous cost data, W. B. Lawrence", introduced and marked "Plaintiff's Exhibit 123-a".

8218 On page T-8, in Exhibit 123, I get a total cost for drifting in 1899 and 1900 of $71,902.23; that applies to a total length of drifting of

11,812.7 lineal feet, and I have excluded 500 feet of open cut from that. That is not all the open cut there was there, as there was what we call the Clark Tunnel that was constructed as an open cut, which I have also excluded. The 11,812.7 lineal feet represent tunnel drifting. The labor cost of drifting and timbering would be $71,902, divided by 11,812, or $6.07. That simply includes the labor.

I am not certain that all of the lumber is included on T-8, but 8219
under the words "of which records were found", is the portion of the lumber as to which I have a record in my office, and so far as my records show, that is all that was used. I have only this reason to believe that those records are incomplete: The purchase of these things was handled entirely in the city, and the invoices were sent out and checked with what we had there, the receipt; there may be something that I know nothing of. It was not the practice of the company at that time to send all material invoices to me for checking before they were placed. I got these records from memoranda I had, and invoices I had that were sent out, but I cannot say that they were all the invoices. The total amount of lumber that I have a record of is 1,075,000 8220
feet of pine, and 6,000 feet of redwood. It would be fair to take $14 per thousand f. o. b. Sunol for pine, in view of the fact that the greater part of the lumber was purchased from $11.95 to $13.95 f. o. b. Sunol. That would be $15,000 for pine lumber f. o. b. Sunol. If you take $15,100 for timber, and divide by the total number of feet, 11,812, it 8221
gives on those figures about $1.28 a foot for timber. We did not receive all the invoices for the lumber, and I dislike to state that that was absolutely all of it. I have no reason to believe that other than that we did not receive the invoices or the bills. That is why I have noted it here that we have taken the quantity of which we have record and put it in here. I am not positive as to whether we received them all or not.

The total of $4,091 for powder is another item that I am not positive is all of it, but so far as we have records, it is all. That will make an addition of about 30 cents a foot. The miscellaneous material, of 8222
which I have no record, in 1901, I estimate at 25 cents per lineal foot, including allowance for salvage. That is not the original cost of it; it is an estimate. The cost of that material in 1913 would probably be more than it was in 1900, so if you use 25 cents, you are probably using more than the original cost; that is a fair assumption. Adding to the cost of $7.34, which is made up of the $1.27 a foot for timber, and $6.07 the labor cost of drifting and timbering, 33 cents a foot for powder, and 25 cents for miscellaneous supplies, will make it $7.94. On the basis of the figures in my Exhibit 123, my labor charge is $100,-897.10, and the cost of the lumber that we have a record of is $18,036.38, and the powder cost would be $3,919.43, making a total of $122,852. That would figure $10.65 a foot; that is on T-11. That includes the 25 cents for miscellaneous materials. I am not satisfied 8223

that this miscellaneous list of material is complete, and I am not satisfied with the lumber as being complete. I used it in my estimates, as that is all I had the records of. I could not say what should be added to the total to make it complete. I am only judging it is not complete by this fact: That in the beginning of the work in 1899 and 1900 we received all the invoices and bills for this work, but later we did not receive all of them, and I tried to get all I could; they were not sent out to the job. That is all I am basing them on. At the be-
8224 ginning of the work we received all the invoices, and I base that statement on my own knowledge. It was reported to my assistant that they were not all received. My assistant went to the office and dug up some of the material that we had not received invoices for, but whether he overlooked any of them or not I could not say.

I did not have charge of the work. I was there frequently, and I had all these records kept, and I looked after the time-keeper's end of it. My assistant, who is with me now, was over there in charge of it at that time.

I cannot state any of the property which appears on the face of list T-10 to have been omitted. The 25 cents per lineal foot is an estimate of the material that has gone in there, my valuation of these
8225 things. I didn't have the cost of what they would be. I got the total of them and divided it by the lineal feet, and it brought it to 25 cents. Taking what items we had on this list, and estimating the balance of which we had not the prices, it brought it to 25 cents a foot, and I depreciated the items that were used, and which you could obtain salvage for. I took a similar list as this and put the prices opposite each, and then added it up and got the total number of feet, and got 25 cents, and where we did not have costs, I put in my opinion as to what the items would cost.

In resolving my figures from 1900 to 1913, I made the same direct resolution between a 10-hour day and an 8-hour day as I did before, and I figured my wage schedule on the basis of putting my foreman
8226 at a uniform rate in 1913 as against a split rate in 1900, paying all my carpenters $5, without any reduction for helpers, and using prices on my two-horse teams and four-horse teams, which are identical with the prices I used on the Peninsula. I don't know that we were getting very much lower prices on the Calaveras in 1913 than that; the company owned the equipment there, and rent the mules they are using. I have not figured that.

In Exhibit 123 I reach a cost of $13.34 for concrete per lineal foot in 1913. There again I have made a direct resolution of my 1900 prices to 1913 on a basis of 10 to 8, and I used the same prices on teams as I do on the Peninsula in my other figures. The lumber costs on my estimate there were taken on the purchasing agent's figures for 1913.

The $1.72 per yard for concrete rock—top of page T-13—is an estimate. One time I kept a record, and I have a memorandum that it cost $1.15 for crushing our rock at the Davis Tunnel. That was all the information I had. I did not consider whether the company would 8227
quarry, or buy it at a quarry at this rate. I just put it in that the cost there should be the cost in this case. There is practically 50% added there. That was the cost, $1.15, that I had in 1898 per cubic yard. You must bear this in mind that this was in 1898, and labor was very low then. You would have to add to that figure. The $1.15 is the 1898 cost without the 50%; you have to add that to it. It re- 8228
fers on the same page to page T-15; "The advance in labor prices "from 1900 to 1913 would be more than 50% increase, and 50% in- "crease is used because crushed rock could be purchased and shipped "from the outside for the price thus estimated." I think we got the price of crushed rock from the purchasing agent, and estimated the hauling.

My total cost per lineal foot in 1913 worked out $23.99 for everything. As a matter of interest I might state, that for the Sunol Aqueduct Tunnel I have estimated 15,011 barrels of cement. That was estimated by taking one barrel of cement to 22 cu. ft. of rock. I found a note that I made in 1900, since these computations were made, which I think would give 17,600 barrels of cement that were used in these tunnels. My estimate for 1913 was 15,011 barrels, and I got that from the amount of rock that was used in the tunnel.

Referring to sheet T-2, Exhibit 123, I have a criticism as to the 8229
lumber and miscellaneous materials given there. I had charge of the work on the Stone Dam tunnels, and the lumber was shipped to San Mateo to my consignment. This is the same thing as the other; some lumber was sent out there on which I did not receive the invoices, and the prices. I stated in the beginning that this was what I had a record of, and that these quantities were used. The books of the company were not kept in my office, and I am not positive that I have all of it. It was difficult at times to get it. I surmised that I did not get all the records from the fact that all the records did not come to my office, and I would send to the city office to get them, and I would make a memorandum of them and put them on my records that I had at Millbrae.

I have a cost of $10.13 on my 1913 estimate per lineal foot, and I 8230
think the lumber for timbering is included in that, and also an estimate of miscellaneous material for 25 cents a foot. On the concrete lining of that I get an estimated cost of $14.10. That makes my total cost per lineal foot, drifting and lining, $24.23 per foot. The rock for the concrete for the Stone Dam Aqueduct Tunnel I did not figure would be secured from a quarry near the tunnel. That is referred to on T-5, hauling rock from the crusher to the tunnel inlet and outlet; that was by contract. I used that figure, I think, in this case. That

is, for the hauling of the rock I used the same figure, but the quarrying and crushing was taken from the memorandum showing $1.15, and
8231 adding 50% for increase in labor.

RE-DIRECT EXAMINATION BY MR. GREENE.

It was not my duty to keep costs at Millbrae, but I have the costs that I actually had, because I was interested in the work, and kept all that data I could get hold of.

The 17,000 barrels of cement that I referred to, is a different figure from the one I used. When I started to look up this data, I went through everything I had to find anything bearing on the subject; after this was completed and turned over, I happened to look in a little note-book I had, and I found a note that there were 17,600 barrels of cement used in the Sunol Aqueduct Tunnel. I think I had the cuts separate, but I would like to verify that. Those open cuts were included in the tunnel construction, but what we call the Clark Open Cut was not included.

Ellis

Witness: RANDALL ELLIS for Defendants.

8233 DIRECT EXAMINATION BY MR. SEARLS.

The excavation work that is comparable with flume benching, with which I have had considerable experience, was the construction of the Standard Electric Canal, in Amador County, in the Canyon of Mokelumne River. This canal was about 20 miles in length, and it involved all classes of excavation, from hard granite down to earth, and had an aggregate yardage of somewhere in the neighborhood of 550,000 to 600,000 yards. This work was done by the Standard Electric Company, of which I was the superintendent of construction. It was carried on by day work under my direction, with our own forces; there was no contract work. The major portion of the excavation work and the flume work that I did was carried on during 1901. I assumed charge of construction in the fall of 1900, and we completed this department in the winter of 1901. In constructing the Standard Electric Canal, the bench was excavated first, from which the ditch cut was taken on out. The benching for this ditch was in every way comparable to flume benching; if they had seen fit to put a flume on this bench, it was ready for it, it was excavated and carried out to grade.

We had to take the same care in carrying our bench to an abso-
8234 lute grade, and avoiding bumps, that we would have had to do if we were building a flume; in other words, this was cut to an even grade, from which the ditch would be taken on out. The work also involved certain expense which is not always found in flume benching; that is, the inside slope of the bench was carried on an even ¾ to 1 slope, and all trimmed with mattocks on account of the possibility of slides, and

also to make the inside of the slope conform to the inside of the ditch slope when it was excavated; in other words, after this slope was cut it would run uniform until it ran out. There were three general classes of material, hard granite, slate and earth. The earth had some percentage of loose rock in it, but where it could be handled without powder, it went into our classification, "earth". Above a certain division, about halfway down the canal, the rock work was practically all mountain granite, while below that the granite ran out, and we were in the slates. The granite was the hard Sierra granite. This that we met with along the line of the canal was quite hard rock, and rather refractory.

The cost of the earth benching—this covered an item of 51,900 cu. yds. where the bench was absolutely distinct, and the costs kept separately—amounted to 28 cents a cu. yard. That was the cost over all. It included tools, materials, equipment, and field supervision. The cost of the granite per cu. yard was $1.01. The cost of slate averaged 75 cents. I figured that our working day in the Sierras then was 10 hours. Our labor schedule for muckers and rock men was $2.25 for laborers, and $2.50 for rock men, with some of the rock men of a higher class getting $2.75. I figure that the comparable cost today on a 9-hour basis would be, for the earth work, 33 cents, for the granite work, $1.20, and for the slate, 88 cents. I assume $2.50 for common labor, and $2.75 for drillers. We did not have to employ any miners on that work; just open-hand drillers and churn drillers. There is, usually, on the top work, a relation of about 25 cents increase between the ordinary labor and the men handling the drills. When I was paying $2 years ago for common labor, drillers commanded $2.25; when I was paying $2.25 for common labor, drillers were commanding $2.50. That seems to be about the ratio. Our 1913 costs would be 33 cents for earth excavation, $1.20 for granite, and 88 cents for slate, using these increases. That is so much for the Sierra excavation. 8235

I did some work in the Crocker Tract here in sand. In connection with what they call the soft sandstones on the Peninsula, and in the neighborhood of San Francisco; in building the Crocker Tract, we excavated all the rock for building our streets; we got out our own macadam. When I was handling it we worked from a number of quarries, selected at different points. The work was all hand work, but was not of sufficient size to attempt to use any equipment. My costs for drilling and shooting that ground, and for the formen at that time, were 16½ cents a cu. yd.; the material was shoveled into wagons, and subsequently hauled to the streets. The shoveling and unloading the wagons amounted to 16 cents more, or about 32 cents altogether. This same work, I estimate, would cost 40 cents today, and that is based on 9 hours, but on increased wages. I was using 9 hours there. 8236

I am familiar with the flume of the Spring Valley in the Sunol Canyon. I have been over a portion of the line from the Stone Dam down. I have seen considerable of the flume work in the neighborhood
8237 of Pilarcitos. I have seen the Crystal Springs Pump Flume. I am familiar with all the flume work on the Lake Merced Ranch. At the time I visited these flumes, I noted in a general way the character of the rock, and the material that was excavated. I am familiar with the general character of excavation to be encountered in the Spring Valley district.

I made an estimate in this way of the unit cost of excavating in the different kinds of material that would have to be excavated in reconstructing the Spring Valley flumes as of December 31, 1913, from such familiarity as I had with the country, and the classes of material encountered, the probable range of costs on the three classes specified in the inventory. The ordinary earth costs on the Spring Valley system are higher, and would be higher considerably, than the sand costs in the Merced. I have looked at that sand excavation in the Merced Rancho, and I know the nominal costs to do it. I made some figures on it several times. It is the easiest kind of excavation, and not worth more than 20 cents a yard. I have handled stuff with longer hauls, that is, hauling it 250 feet, and spreading it out for 17 cents and 18 cents. However, that only applies to about between 10% and 15% of all of the excavation of the Spring Valley.

The earth work, based largely on the results of similar excavations in the mountains, which, if anything, was more difficult, I have figured would have a range between 30 and 35 cents. The earth work on the Spring Valley as a whole would probably fall in the neighbor-
8238 hood of 32 cents.

The general average of solid rock on the Spring Valley, I think, would run in the neighborhood of $1, although some may be encountered that would run $1.25. I consider $1.25 would be a maximum, as I consider you can take out granite for that. I have not had a chance to weight the figure sufficiently to determine just what it would be. I am not absolutely certain as to the interpretation of the term "loose rock" in the inventory; that is, I don't know just where the loose rock begins and just where it ends. However, taken as a general average of what loose rock is ordinarily considered, and considering its range through this country, I consider that the cost of the loose rock would run about 65 cents in that neighborhood.

When I say a general average, I mean classification of material, and viewing it in the light of costs on this Crocker Tract, the quarrying costs there, and such additional costs as would be necessary to trim down and dispose of the material; also as figuring the range of loose rock work more or less in comparison with the earth work and solid rock, I have had a great many opportunities to notice it in con-

nection with contracts that we have had on that class of work, on scraper work on railroads. I am not referring to heavy steam shovel work, but simply to ordinary scraper work where the stuff had to be excavated and brought to a surface, or to a grade, the same as you 8239
would bring it to a grade in laying a flume. In the southern country, in railroad work of that character, we used to get 13½ cents for earth finished in the embankment; 35 cents for loose rock, and from 65 to 75 cents for solid.

In resolving from 10 hours to 9 hours on the Sierra work, I did not make the direct resolution, but added about 6%. In our studies of trenching for pipe laying in San Francisco, in connection with the recent gas appraisal, the trenching and backfilling costs were developed by the Pacific Gas & Electric Co. from a large range of jobs over the last three or four years since their superintendent, Mr. Keppleman, has taken charge. Mr. Jones had these compiled with a great deal of care, and they were quite complete. We also had the complete detail records of laying gas pipes in San Francisco in 1901 and 1902 of Mr. A. M. Hunt, who was the builder of the Independent Gas System here. As a test of this matter of wage and labor resolution, and as a matter of curiosity, we made the comparison. The difference in hours and wages between 1901 in Mr. Hunt's time, and the schedule of the Pacific Gas & Electric Co. at present, would have indicated an increased cost of 60%; the actual increased cost was under 20%. Those were two practically identical jobs, they were paralleling each other, and they were treated the same in each man's figures. That was purely a 8240
labor job, trenching and backfilling.

Questioned by Master.

That is a resolution from 10 hours to 8 hours. The greater portion of the Independent System was put in on a 10 hour basis, with $2 a day labor. With the Pacific Gas & Electric work it was 8 hours, and they have been paying their ordinary men $2.75, or 25 cents over the schedule. They found, from their experience on costs, that they could get a lower cost than if they paid $2.50 for 8 hours, by reason of that extra 25 cents being a sufficient incentive to hold their men; a man has to be a good man to stay with them. So the resolution would be in the neighborhood of 20 cents an hour in one case, as against the average of the Pacific Gas & Electric Co. over the whole period; we are considering a 5-year period with them, it was something under that; so that their average was somewhere in the neighborhood of 32 cents an hour during this period. The direct resolution would have been a 60% increase, and the actual facts showed something under 20%.

You will have to take into account, to a certain extent there, the difference between systems being constructed, a system like the Independent Company, under Mr. Hunt, and a system that is under a com-

8241 pany in existence, like the Pacific Gas & Electric Co., but at the same time the divisions on which these costs were determined were all large divisions; the ordinary small extensions had not been taken into consideration. We were taking large structures, where we considered that the amount of pipe laid was fairly representative of reconstruction work. The range of sizes of those divisions on the Pacific Gas & Electric Co.'s job that I referred to ran from 800 to 1,000 feet up per job. The nucleus of each of those crews were the regular men; in other words, a construction foreman of the capabilities of Mr. Keppleman, and he has a number of good men in his gang; in forming his new gang for extensive work, he splits these men up and they are more or less pace-makers. That is true of all construction; if you have 15 or 16 camps going, you do not put all your good men in one camp; you will pick out representative men in different lines who are good men and put them in different camps, and they are sort of pace-makers for the gang.

8242 The figures I have given for the Spring Valley flumes are for a 9-hour day and 1913 wages. This includes not only field overhead, but all tools, and matters of that kind; everything exclusive of general overhead; there is no engineering or interest during construction in here at all. I intended them to be taken as comparable with Mr. Hazen's figure, but my figures do not carry a contractor's profit, because that is the basis of the Sierra figures, the work was not contracted, and included all the costs to the company, including forces which a contractor would have had to carry, but which the company carried; it is along the same lines as Mr. Lippincott's figures. We did this work the same as the aqueduct did theirs.

These final figures I gave you of 32 cents, and in the neighborhood of $1, and 65 cents, are directly comparable with Major Dockweiler's figures, Mr. Dillman's figures, and Mr. Hazen's base figures on the
8243 same thing; in other words, if I simply took the resolved cost, I would have about 33 cents in one case, where I have used 35 as a weighted figure. I intended these figures to be contract figures, which would involve a profit comparable with those; the final figures as a probable average of 32 cents on earth, in the neighborhood of $1 or $1.10 on solid rock—between $1 and $1.25—and probably 65 cents on loose. We considered 9 hours work on the Peninsula. If it were 8 hours, I think it would mean another increase in the neighborhood of 6%, or a fraction over. In a resolution from a 10 to an 8 hour day, just as a matter of opinion and observation on that question of hours, I figured about 12½% interest in cost; it would be probably in the neighborhood of 6% or 6½% as I used it here. That is something that could not be determined with refinement.

Questioned by Mr. Greene.

I get that 6% in this way: If you make the direct resolution from a 10-hour to an 8-hour day, figuring that in 8 hours a man does

.8 as much work as he does in 10 hours, it means 25% increase in your cost. That is, he will work 80% of the time, and it will cost 25% more to do a given piece of work. I figure, however, from my experience, that the difference between an 8-hour day and a 10-hour day, the only 8244
advantage that you get working men 10 hours as against 8 hours, is a possible increase in output, as, if they had worked 9 hours at the same ratio as if they worked 8 hours, it is the gain of one hour which would be 12½% increase. So, resolving between a 9-hour and an 8-hour day, I simply assumed a split of the difference. It is something that cannot be absolutely determined. It indicates, if anything, from these figures with reference to the Pacific Gas & Electric Co., and the Independent Company, that the 6% is a little high.

DIRECT EXAMINATION BY MR. SEARLS.

I picked out the equipment costs of the Central Reservoir to see what they amounted to in the aggregate, and by equipment costs, I mean the figures which include the rental of machinery, stock, and so on, but not including with the teams the driver and the feed of the stock. As near as I could determine from the schedule, the equipment cost involved in the job is $34,651, which is about 18½% of what is classified as direct costs, referring to the exhibit that we put in on the Central Reservoir, in which an attempt was made to segregate certain costs as being indirect, and certain as miscellaneous earth work. If you add the miscellaneous cost to these figures, it would 8245
show a total cost of 22%. That is, covering the original indirect, which, according to our classification amounted to somewhere in the neighborhood of 3%, or a little over.

Questioned by Mr. Greene.

As to the quarry at the Central Reservoir: All I did here was simply to take these figures, and these are all the figures that are shown as being the cost of the contract into which the item of quarry comes; whether the quarry is distributed through the concrete work or not, I don't know, but if it is, it is in the direct costs. I presume it is put directly into the cost of the stone, because I noticed that the stone was filled at so much per yard.

Witness: Allen Hazen for Plaintiff. 8246

Hazen

Mr. Hazen: The question of contract came up. It is my thought that on some kinds of work that enter into the construction of this system, that the Spring Valley Water Co., with its own men, could do the work more advantageously than it could be done under contract, and that they would do all such parts of the work in that way; that would include the laying of pipes in the city, and I certainly think they would not want a contract there. There are other parts of the

system where I think a contractor could do the work cheaper than the company could do it; the contractor could do the work and make a
8247 profit, and do it to better advantage to the company than the company could do it by day labor. Just what parts those would be, I have not altogether separated. Wherever I thought the work could be done advantageously by contract, I assumed that it would be done, and I assumed that the contractor would make a profit that would be normal for those parts of the work. In a general way, I think, that would cover the dams, and the outside pipe lines, and perhaps the tunnels.

Generally speaking, the company building this system, with good average engineers, such as they would be likely to have, would have, in their organization, men normally with experience, and equipment and capacity for building a structure like the Crystal Springs Dam, comparable to what a good many contractors have. It is my notion that they could let a contract for that, and that a contractor could do those parts of the work, and make a profit, and do it more advantageously to the company than it could be done by day labor, and take all the risks of bad methods, of accidents, and all that would go with it; in other words, I am assuming that they would use the contract, or the day labor system, whichever was best adapted to each particular part of the work. It seems to me when we get contractor's costs, if we can get them, which we very rarely can, because the contractor is not under any obligation to give us those figures, if he does it, he does it voluntarily, and we are not oftentimes sure as to what it includes, but if we assume that the principal can do the work at the same cost as the contractor—I don't think it is a fair assumption—it is not justified by facts. The contractor can normally do the work cheaper than the
8248 principal can do it; otherwise, there would be no object in letting the contract. In connection with such figures, a profit must be figured. In connection with work that is normally and advantageously done by day labor, by the principal, and it had best be done that way, in that work I have not assumed any contractor's profits.

(The following was read in the form of a stipulation, because Mr. Searls and Mr. Greene prepared it jointly).

It is agreed that after having found the value of the Lake Merced lands, as of December, 1913, the following percentages for the respective rate years set forth opposite them shall apply:

1914-15	100%
1913-14	100%
1912-13	100%
1911-12	90%
1910-11	85%
1909-10	
1908-09	
1907-08	75%

It is agreed that these percentages are reached purely for the purposes of determining the value of the Merced lands at the various fiscal years in controversy, and that they shall be considered only for that purpose, and that they bear no relation, and shall not be treated as 8249
having any relation to the dates of particular sales referred to in the record.

Mr. Searls: To illustrate that: Supposing you had a sale in 1907 at $100 an acre, and another sale in 1910 at $125 an acre, we do not wish to be considered on either side as agreeing to the effect that because there was a 25% increase between 1907 and 1910 that that has any relation to the $100 sale, and to the $125 sale; in other words, that your Honor will use such sales as you see fit in reaching a value as of December 31, 1913, and then just apply these to it.

Witness: C. E. GRUNSKY for Plaintiff. 8250

Grunsky

Mr. Grunsky: I was requested to prepare some figures with reference to what the effect would have been on the first approximation of the cost of reservoir lands, and of watershed lands, if certain tracts of land had been brought under consideration, which I had not included in making my original first approximation. I have presented the results of this additional study in tables, which are numbered Table 26 and 27 to and including 33. The first four of those tables refer to land at the Crystal Spring Reservoir, and the last four refer to lands at the San Andres Reservoir. It will appear from Table 26, which relates to Crystal Springs Reservoir, and the price paid for watershed lands, first approximation, on the basis of the average price paid per acre for selected tracts, that with the inclusion of the tracts that were referred to by Mr. Searls as having been omitted from consideration in making my first approximation, the average cost per acre of watershed lands would have been approximated at $51. In Table 27, where also the various tracts that were referred have been included, the average cost per acre of reservoir lands is $188.

These are first approximations, and they indicate that it is certain that the ratio between the price paid for reservoir land and that paid for the watershed was about 4 to 1. The ratio is really 3.7, as these figures express it, but as the reservoir land is introduced at too low a figure, and the watershed land at too high a figure, obviously the ratio is undoubtedly somewhat in excess of 4 to 1; but using that ratio 4 to 1, which has been indicated by that first approximation, and using the same tracts of land again, the result is shown in Table 28 8251
and Table 29, showing a probable average price paid for watershed lands of $38, and the price paid for reservoir land as a second approximation, $406, or a ratio of about 10 to 1. I note in the heading of the table which I have prepared, the ratio is given as 3.6 to 1. That is an error of the typewriter, it should be 4 to 1. The matter was not fol-

lowed any further than that, because the 10 to 1 ratio as originally used indicated a per-acre cost for watershed land of, in round numbers, $42, and the price paid for the reservoir lands at $421; so that these figures, $38 and $406, are fairly approximate to the figures originally used. If I had carried the approximation further, and had made the selection of lands as I should have preferred to make it, the per-acre cost as given in Table 28 as $38 would have been somewhat less.

In Table 30, San Andres Reservoir, price paid for watershed lands, first approximation, on the basis of the price paid for selected tracts, the various tracts that were referred to by Mr. Searls have been included, and the first approximation of the cost of the watershed is $34 per acre. In Table 31, by similar procedure, and here also assuming that the average price paid for the entire tracts might, as a first approximation, be applied to the reservoir lands only, the first approximation of the price paid for the reservoir lands is shown at $96. $96 compared with $34 indicates a ratio of about 3 to 1, and using that ratio in order to make a second approximation, as shown in Table 32, the second approximation as to the price paid for watershed lands is $28, and as shown in Table 33, the price paid for reservoir lands as a second approximation, is $106, this being a ratio of about 4 to 1, which would be nearer correct than 3 to 1. Two tracts of land were included in Table 33, Tracts 13 and 14, which do not appear in Table 31. There is nothing in these figures that I have now prepared that in any way changes the conclusions that had been reached before.

8252 Table 26.

CRYSTAL SPRINGS RESERVOIR.

Price Paid for Watershed Lands, 1st Approximation, on the basis of the average price paid per acre for selected tracts.

Tract No.	Watershed Area Acres	Cost per Acre	Totals
39	2,094.05	$ 17.86	$ 37,400.00
90	856.10	124.45	106,400.00
48	925.88	60.25	56,800.00
49	643.90	23.49	15,100.00
72 & 73	285.25	85.00	24,200.00
41	42.45	133.48	5,660.00
42	22.38	175.00	3,920.00
Totals and Means	4,870.01	$ 51.00	$249,480.00

First approximation of cost of watershed is $51 per acre.

Table 27. 8253

CRYSTAL SPRINGS RESERVOIR.

Reservoir Lands. 1st Approximation of Cost based on the price paid per acre for selected tracts.

Tract No.	Res. Area Acres	Cost per Acre	Totals
41	2.50	$133.48	$ 330.00
94	9.50	709.24	6,730.00
92	48.70	406.19	19,800.00
96	11.45	274.84	3,150.00
47	21.50	212.01	4,560.00
68	150.27	404.72	60,900.00
37	166.00	30.00	4,980.00
44	12.40	85.43	1,060.00
55	74.24	120.00	8,910.00
50	170.90	87.17	14,900.00
Totals and Means	667.46	$188.00	$125,320.00

The first approximation of the price paid for reservoir land at the Crystal Springs reservoir is $188 per acre, or compared with $51 per acre for watershed in round numbers about 4 times as much.

8254 Table 28.

CRYSTAL SPRINGS RESERVOIR.

Watershed Lands. 2nd Approximation of Cost based on the first determination of the ratio of the cost of reservoir land to the cost of watershed land.

Ratio 4 to 1 (See Table 27).

No. of Tract	Res. Acres	Watersh. Acres	Total Cost	Estimated cost of Watershed per acre	Estimated Total Cost of Watershed
39	68.20	2,094.05	$ 38,624.00	$ 16.30	$ 34,200.00
90	125.40	856.10	122,150.00	90.00	77,000.00
48	235.90	925.88	70,000.00	37.50	34,600.00
49	15.90	643.90	15,500.00	21.90	14,100.00
72 & 73	32.10	285.25	26,975.00	6.50	18,500.00
41	2.50	42.45	6,000.00	114.50	4,860.00
42	0.00	22.38	3,917.00	175.00	3,920.00
		4,870.01		$ 38.00	$187,180.00

The second approximation of the price paid per acre for the watershed lands at Crystal Springs reservoir is $38.

Table 29. 8255

CRYSTAL SPRINGS RESERVOIR.

Reservoir Lands. 2nd Approximation of Cost based on the first determination of the ratio of the cost of the reservoir land to the cost of the watershed land. Ratio 4 to 1 (See Table 27).

No. of Tract	Res. Acres	Watersh. Acres	Total Cost	Estimated Cost of Res. Land per acre	Estimated Total Cost of Res. Land
41	2.50	42.45	$ 6,000	$ 465	$ 1,160
94	9.50	4.95	10,249	954	9,050
92	48.70	31.31	32,500	575	28,000
96	11.45	12.20	6,500	448	5,130
47	21.50	49.25	15,000	444	9,550
68	150.27	829.77	396,645	1,110	166,700
37	166.00	350.43	15,493	61	10,120
44	12.40	9.46	1,868	126	1,560
55	74.24	24.70	11,873	148	10,950
50	170.90	310.90	42,000	169	28,900
Totals and Means	667.46			$406	$271,120

The second approximation of the price paid for reservoir land at Crystal Springs reservoir is $406 per acre.

8256

Table 30.

SAN ANDRES RESERVOIR.

Price paid for Watershed Lands, 1st Approximation, on the basis of the price paid for selected tracts.

No. of Tract	Watershed Area Acres	Cost per Acre	Totals
18	83.55	$ 91.95	$ 7,670
13	375.30	24.44	9,160
43	391.69	29.25	11,470
130	390.04	15.38	6,000
14	175.26	27.07	4,750
51	17.52	80.00	1,402
15	143.35	70.00	10,034
42	22.38	175.00	3,917
Totals and Means	1,599.09	$34.00	$54,403

Table 31. 8257

SAN ANDRES RESERVOIR.

Price paid for Reservoir Lands, 1st Approximation, on the basis of the price paid for selected tracts.

No. of Tract	Reservoir Area Acres	Cost per Acre	Totals
18	35.70	$ 91.95	$ 3,280
17	14.30	120.00	1,720
20	19.70	120.00	2,360
19	23.80	120.00	2,860
21	13.80	120.00	1,660
16	28.50	120.00	3,420
12	78.30	66.27	5,190
Totals and Means	214.10	$96.00	$20,490

The first approximation of the average price paid for reservoir land at San Andres reservoir is $96 per acre which is in round numbers about 3 times as much per acre as the 1st approximated cost of Watershed Land.

8258 Table 32.

SAN ANDRES RESERVOIR.

Price paid for Watershed Lands, 2nd Approximation, based on the ratio of 3 to 1 determined by the first approximation.

No. of Tract	Res. Area	Watershed Area	Total Cost	Est. Cost per acre	Est. Cost of Watershed
18	35.70	83.55	$10,965.00	$ 57.70	$ 4,820.00
13	156.65	375.30	13,000.00	15.30	5,740.00
43	1.00	391.69	11,488.00	29.30	11,400.00
130	0.00	390.04	6,000.00	15.40	6,000.00
14	59.30	175.26	6,350.00	18.00	3,160.00
51	0.00	17.52	1,402.00	17.52	1,400.00
15	10.40	143.35	10,762.00	61.67	8,840.00
42	0.00	22.38	3,917.00	175.00	3,920.00
Totals and Means		1,599.09		$28.00	$45,280.00

The second approximation of the average price paid for Watershed Lands at San Andres reservoir is $28.

Table 33. 8259

SAN ANDRES RESERVOIR.

Price paid for Reservoir Lands, 2nd Approximation, based on the ratio of 3 to 1 determined by the first approximation.

No. of Tract	Res. Area	Watershed Area	Total Cost	Est. Cost per acre of Res.	Est. Cost of Res.
18	35.70	83.55	$10,965	$173	$ 6,180
17	14.30	17.39	3,802	189	2,710
20	19.70	16.90	4,392	173	3,410
19	23.80	43.12	8,030	220	5,240
21	13.80	20.72	4,142	200	2,760
16	28.50	67.61	11,533	226	6,450
12	78.30	102.79	12,000	107	8,370
13	156.65	375.30	13,000	46	7,210
14	59.30	175.26	6,350	54	3,200
Totals and Means	430.05			$106	$45,530

The second approximation indicates that a ratio of $106 to $28 or about 4 to 1 would be nearer correct than 3 to 1 as ascertained by the 1st approximation.

8260 I might add, that the first approximation is in each case based upon a ratio of 1 to 1, simply selecting those tracts which best indicate reservoir cost, for the purpose of determining the average price that was paid for reservoir lands, and those tracts which best indicate what was paid for the watershed lands, to determine the average price paid for watershed. When the first approximation was made on the basis of the ratio of 1 to 1, the second approximation was based on assuming that the reservoir land had a greater value than the watershed land in the ratio of those two amounts per acre, as determined by the first approximation. That is exactly what I did. I took the average value per acre of the tracts I have selected as representing probable watershed costs, and then segregated them on the basis of their actual watershed and reservoir areas. Then I apply, as between each of those areas, to the average price, the ratio which was indicated by the original comparison of lands, selected for representative purposes, and then that gave me a second approximation for the price paid for reservoir lands and the price paid for the watershed, and that was again used in the same way. Then I add these indicated figures obtained in that manner, and take the average of those, divided
8261 by the actual watershed, or reservoir acreage, as the case may be.

There are two ways in which you may proceed; one is by in some way approximating either the price paid for the reservoir land, or the price paid for the watershed; applying that price then to the reservoir land, and substracting it from the total, the remainder will be what was paid for the watershed in the case of beginning with the reservoir land; the other is to determine approximately how much more was paid generally for the reservoir land than for watershed, and applying that ratio. The first may lead to absurd results. To illustrate: We may have a tract of land that is equally in the watershed and the reservoir; if the approximation of the price paid for the reservoir is so large that when applied to one-half of that tract which is in the reservoir,
8262 it amounts to more than the cost price, we would have the watershed costing nothing, simply thrown in; therefore, that method of procedure was not applicable, excepting to certain selected tracts, where some idea could be obtained even in that way, and which was used in the statement which I made several days ago. Here was the thought that was in my mind when I made the segregation of the total cost price of any particular tract into the amount paid for reservoir land, and the amount paid for watershed: If I could approximate with some degree of certainty the cost of watershed, and would apply that to the land that was watershed, the remainder would be the reservoir. If the watershed predominated in any tract, and I had only a few acres of reservoir land, and would apply the approximate price paid for

the reservoir, and deduct that from the total purchase price, I would get a better average cost per acre of the watershed than I would if I simply took the general average of the entire tract.

On page 4 of the table before this, on this same matter, the 8263
average cost of the tracts selected for watershed was $50, and the average cost of the tracts selected for reservoir purposes was $380 an acre, and I called it 8 to 1, and then continued the analysis on that basis.

Questioned by Mr. Searls.

The size of the tract was taken into consideration throughout, and particularly the relative amount of each tract that was within the reservoir and without the reservoir. Practically all the tracts included in the reservoir were very small tracts, while practically all the tracts included in watershed land were very large tracts, and leaving all question of reservoir value out of consideration, the price per acre might vary on that basis alone, but all that was taken into account, because the relation that the individual tract bears to the entire area was taken fully into account in determining the average price paid. I think it is
true that the tracts that were taken into account in connection 8264
with determining reservoir costs were small as compared with those that were taken into account in determining watershed costs. In the Crystal Springs Reservoir, the aggregate of all the tracts that were examined, and concerning which I have given information in Table 19, aggregated 1,337 acres, and the lands in the watershed 7057 acres, so it was quite natural there should be larger areas taken into account in considering the watershed cost than in considering the reservoir cost. In so far as the price per acre was under consideration, it made no difference whether there were improvements on the tract or not, because the ultimate result was the acquisition of land as land, and I was interested in what that land had cost. I made no assumption in my valuation that a side-hill watershed land was of the same agricultural value as the reservoir land.

In making the first approximation of what was paid per acre 8265
for reservoir land, the San Mateo Waterworks purchase I included as reservoir land.

Mr. Grunsky: I found that in reply to a question on page 1320 of the transcript, the following:

"Q. I understand that. In your opinion, your valuation, as "I understand it, of these lands for reservoir purposes, is there-"fore based upon their use in connection with a public utility, "namely, the marketing of water.

"A. It is. They are valued as properties used in connection "with a public utility."

I did not wish to imply, in giving that answer, anything further than that they were valued as being properties available in connection with a public utility. I did not make any investigation of the value that these properties might have to the public utility that was now using it. That was the point.

Questioned by Master.

In my study here I have not assumed that all sellers of these lands were cognizant of the availability of the property to the uses to which they are now put. I made no assumption with reference to that. Some of them may have been fully cognizant, and others not. The great variation in the prices which were paid per acre, both for reservoir land and for watershed, would indicate
8266 that. The dates of purchase might have something to do with the knowledge of various owners, too.

With reference to Tract 44 in the Crystal Springs, practically all reservoir areas, bought for $85.43 per acre in 1874, and Tracts 45 and 46, being half watershed and half reservoir, approximately, bought the following day in 1874 at $89.70: I think the presumption is that the parties who made those sales did not know that they were in a reservoir area, or if they did know, the reservoir had not been constructed, and the availability of the site had not yet been demonstrated, and there was no certainty as to just when the reservoir might be constructed. It is impossible to determine at this time what could have been in the minds of those parties selling those lands at that time. The cost prices here would indicate better what the price paid was for lands generally in that vicinity, irrespective of reservoir value.

Questioned by Mr. Olney.

8267 To the extent to which the parties at that time were not aware of the value which might attach to these lands for reservoir purposes, the price or ratio of reservoir values to watershed values would be diminished. If these parties had known fully of the availability of the property for reservoir purposes, the presumption is that they would have received a higher price, and therefore the ratio between watershed and reservoir cost would have been increased.

8267½ Questioned by Mr. Searls.

When I testified in the Drinkhouse Case to the $1250 as the value per acre of the reservoir land, I don't recall now how that conclusion was arrived at. I was, as in this case, endeavoring to obtain an idea of the market value of that property. I am quite certain that I did use the studies that have been made of the cost of bringing in water from various sources, in analyzing what the market value of that property was at that time.

(Counsel for Defendants stated the City's position as regards 8268-8269
the matter of reservoir value. He also explained what Mr. Dillman did in reaching his estimate of Crystal Springs Reservoir lands.)

Witness: N. RANDALL ELLIS for Defendants. 8271

DIRECT EXAMINATION BY MR. SEARLS. Ellis

Referring to the cost figures on the Sierra work, which I gave this morning: All matters having any bearing on costs passed through my hands. The only thing we maintained in San Francisco was a general office headquarters, where the president and directors, auditors, etc., were. The main office, where all the segregated accounts were kept, was in the mountains, at Electra, 8272
and I had all that matter under my charge. It not only handled all the accounts in my division—the hydraulic—but also the powerhouse construction, and the pole line work. These costs were not partial costs; every payroll passed through the office, every purchase in San Francisco for the work had invoices in triplicate sent to our office for approval, segregation and entry, and consequently our costs reflect every cost of the work, with the exception of the headquarters office in San Francisco.

Throughout all the work, in keeping up these costs, this was done: Quite a complete schedule of cost analysis was put in in each camp along the lines that we wished this work segregated on. The timekeeper took the time, and segregated the work each day in conference with the foreman with reference to any suggestions needed. The work segregation at the end of the day had to be balanced against the payroll of the day. At the end of the month, when the total segregation sheets were summarized, and compared for labor with the total payrolls, we would permit a variation up to 1% between labor segregations and the actual payroll totals, due to the fact that at times there were always slight variations due to splitting up of days, and to some overtime allowance, and so on.

I consider anything under 1% as sufficient for the purpose of my segregation. All materials for the work, for this ditch work particularly, passed through a central warehouse, located at Tabeaud, and entered there, and records kept, and it was charged out to the job for which it was issued. Complete inventories were kept in each camp of all receipts and disbursements of materials. I kept a special man whose duty it was to see that all accounts 8273
were kept properly, and so on, and the final account at the end of the month, and at the end of the year, was reconciled with our books at Electra. That told the final story of our disbursements. Our general segregation sheet was made out from that and sent

to the city office, which they used in making any allocation to their general accounts. The costs I consider as being very complete, because every element that entered into the compilation of them was directly under my charge. I have preserved those costs in a note book which I have used.

CROSS EXAMINATION BY MR. GREENE.

The same items which I have given here would not appear on the general books of the company. For instance, on ditch construction, they would probably have one account for ditch construction. They would have vouchers covering everything that is here, but the general books would not show any such segregation as we show here. This is what was done: All vouchers covering
8274 materials and invoices were segregated on their face, and all payrolls; a copy was generally sent to the office here of the general segregation sheet which applied to all payrolls. I made the rules with regard to the segregation. I had handled this class of segregation on previous construction, when I was an assistant in the building of the old Blue Lakes plant. I had my ideas pretty well defined as to just how I wanted this kept up. I took charge of the division the latter part of 1900, I think, and I had the system in thorough operation by the first of January, 1901.

It is very easy to segregate between rock and earth. In any one camp, as it happened on this, the rock was either of one character or the other, either granite or slate, but not both. About the upper 10 miles of the canal was in a granite country. After it passed into the lower country, it went into slate, in which there was no granite. It was very easy to segregate between them.
8275 Where it was rock work it was either slate or granite, dependent upon the camp. The classification of material is not left to the timekeeper at all. The timekeepers classify under certain instructions, and in conference with the foremen. They were all fairly well informed men on that work. My engineer that I had over this ditch division made monthly cross-sections, and monthly classifications of all the materials that were used. Those quantities and those classifications were taken from the engineer's reports which were made monthly. The timekeeper did not do that. It was in that way that I got my figures as to the amount of granite, or shale, or earth, that might be moved.

If you were familiar with that class of construction, you would know that it is extremely easy to keep segregation between the cost of doing earth work, and the cost of doing rock work, in that Sierra country. It did not go with a little layer of earth and then a little layer of rock, and so on, but there would be long
8276 sections that were rock, and then you would come to an earth section. The rock section, and the work on the rock section was

usually handled by rock gangs, who usually went ahead and drilled and shot, and they were followed by the muckers; we never experienced any particular trouble in keeping that segregation on down to what I considered an extremely fine point.

The timekeepers and the foremen, under instructions, and under consultation with the engineers who were along there, knew exactly what to classify as earth, and what as rock, and made the charges accordingly. It is exactly the same as on railroad work: I have done hundreds of thousands of yards of railroad work which come under the same proposition. The railroad company will pay you three different prices; earth work, loose rock, and solid rock; there is never any great difficulty in segregating it out, although the conditions are just the same. It is not any different in the case of the railroad than when you are taking a gang, as in this case, working on two or three different ones, in explaining the segregation. It is simply based on experience. I have had no 8277
difficulty in keeping track of that, any more than I have had in keeping track of other elements.

If we were to suppose that we had 10 yards of loose rock, and 20 yards of granite, and 30 yards of shale, taken out at a given period, the reduction was not made to the unit figure for each one. The timekeeper, under instructions as to what he was charging to earth work, and to rock work, would have segregated it out on the men working on earth work, and the men working on rock work; that would go into his daily payroll; at the end of the month there would be a grand total of labor chargeable against rock, and the same thing against earth; then the engineer would classify the quantities of each that were moved, and the quantities would be divided into the total to give a unit. They are not absolute to the fraction of a cent, but they are as absolute and dependable as 99% of all construction cost figures are. If timekeepers and men who are gathering the costs and segregations are not sufficiently familiar with their work, the engineer who takes them and uses them is in error to that extent. You have to presume you have men on the job who understand what they do, and that is what we had. My men working on rock work do not go into earth work. We are paying those men more, and they won't 8278
do that work. They work on rock work. The men who work on the slate are rock men; all my slate is what you call down here hard rock. It is softer than the granite, but it is harder than any of the slate you see down through here. It is all shooting ground. We shot it with black powder instead of giant. The work was segregated camp by camp. That was a peculiarity of that place, the granite does not come down. As you approach below, the granite runs out, then you get into the slate and the green stuff.

The main line of flumes I built were the flumes of the Standard Electric, their wasteways. They were flumes on an incline, and aggregated in length all told about 4 miles; of the waste flumes there were about 3 miles, I think; possibly there was other
8279 flume work I did over that system aggregating a mile or a mile and a half. I might have built 8 or 10 miles of flumes. That flume was built largely in 1901 or 1902. Our flumes were not laid on a bench. They were on trestles. Wherever we could get a bench we excavated a ditch on account of the more permanent character of it. With the class of lumber that is available in the Sierras, it has to be cut locally, the flumes are not very long-lived; they will average from 15 years, which is fairly an average, to 20 years as a maximum, consequently, wherever you could get a bench in there, the ditch was excavated out, it having a more permanent character. All our flumes were crossing gulches and canyons, and around cliffs; there was no excavation involved except cutting for the hitches, for the posts. There are no other flumes that I have constructed on the bench that are comparable to the Spring Valley flumes, except that series of flumes in the mountains. As far as benching goes, this benching that I am speaking of is largely identical with flume benching; if we had seen fit to build a flume on that bench, instead of excavating the ditch, that bench was ready for a flume, just as ready as any Spring Valley bench, or anybody else's bench, because it was cut absolutely to grade, and also sloped. The bench was brought on down to a grade when it
8280 was finished; subsequently the ditch crew came along and excavated the ditch on out of that bench grade.

It had to be cut to a grade, because the grade stakes for the ditch cut were set at bench grade; it was cut to a grade there as a matter of convenience for cutting on out the final ditch, and incidentally, there has been considerable emphasis laid on the great cost of flume construction due to the polishing of the grade. It is true there is some extra expense due to getting a firm grade, as against excavating a rough cut, but as comparable with other excavations, flume excavation has the advantage of having one of the cheapest aspects to it than any other thing, because in 99 cases out of 100 it is a waste of your bank. There is no hauling away, or anything of that kind. You can waste it at the quickest available point. The question of surfacing, and so on, where it is a question of earth work; it is no more particular in bringing that to grade than what you are required to do on every railroad contract that I have been on where there has been an earth embankment, and we had to finish it ready for tie setting; it is practically about the same thing. If, in a rocky country, there are projections coming out from the shooting, and so on, that have to be leveled, that adds more expense, but is included in the same

costs I have here. It must also be borne in mind that the benching having to be absolutely true all through does not hold. The flume boards and the flume grade are not laid directly on the bench; they are laid on sills; usually supported by mud sills, and in lots 8281
of cases blocks. Take it along the Merced line of the Spring Valley, there will be blocking under sills. You have your intermediate timbers between your mud sills. The projection of your flume along irregularities that there are in there, doesn't cut any figure, because your flume boards are clear.

I heard Mr. Lawrence, and Mr. Martin, and Mr. Herrmann state the way in which the flumes they built were actually built, and my experience in building flumes warrants me in stating that 8282
they are wrong in that if they say that reflects itself in the excavation. My idea was they said that to justify their high carpenter cost as part of the lumber cost, due to the blocking of the intermediate sills. Mr. Martin is absolutely wrong, because that class of work, putting a finish on a grade, is a class of work that construction men have been doing for years.

Mr. Martin also states that the average cost of excavating rock in the Sierras is $2.75. I am positive I excavated considerably more rock in the Sierras than Mr. Martin has, and a $2.75 charge for cutting out rock, unless you are taking it out of a trench, is excessive. I have quarried probably hundreds of thousands of yards of it in the Sierras. I don't recall ever having heard of granite excavation in the mountains that cost $2.75. I never had that experience, and I built, outside of this excavation, two large rock-filled dams, in which we had to quarry rock, and transport it, and so on. The rock work on those dams, quarried, transported, derrick handled, and laid in the dam, and faced up, averaged about $2 per cu. yd. in the dam. A flume is more com- 8283
parable to a road than a trench. Supposing you were cutting a core wall in the Sierras, and were excavating down 10 or 15 feet, you would probably run into heavy construction costs in the trench just as you would here in the city. A flume bench is a sidehill cut. There is a great range of difference between the cost of trenching and of ordinary excavating from a bench; sometimes one will double the other cost.

There is skin work in preparing for flume excavation, and that is what I considered in connection with these costs. We did the same thing on this ditch grade. The width of the bench was 15 feet. Offhand I think the Spring Valley flumes are 6-foot flumes, and the benches are perhaps 10 feet wide. Taking a section 100 feet long, for a 15-foot bench, excavating as we did in the mountains, as compared with a 10-foot bench, it would cost more per yard. As we cut in, our slopes grew quite high. The inside slope was carried at 3-4 to 1, and was mattock trimmed. Cutting on in 8284

further, that work ran proportionately more expensive, so if anything, I think the costs, with our 15-foot benching, were more than they would have been if our benching had been 10 feet—I mean per yard. With a wider bench, the stuff was more expensive to handle, probably; not only that, but as you widen the bench, your inside cut grew up abruptly, and the finishing of that was an additional charge.

Questioned by Mr. Metcalf:

It is probably true with a narrower section and a smaller flume you would have less material to be removed for a given area than in the work which I had under contemplation, but the offsetting features against any slight difference would be slight in
8285 the difference of moving earth on an 8, or a 10, or a 15-foot section; these costs include a sloping cost, a retaining of material cost, which was peculiar to that job, due to the fact that all of this excavation was done for a new ditch which was paralleling an old ditch which was in existence, and which had to be kept in operation, at 200 feet above it, and consequently the spoiled material was confined between the two ditches, necessitating additional labor on brush walls, and on rock walls, and so on; but all those costs are included in the excavation costs. Those costs I consider offset the little difference due to fluctuations in the width of the bench.

In my trench work it is much more expensive per cubic yard to take out 6 or 8 inches at the bottom of the trench, than it is to take out the full bottom of the trench, and I had that all in mind in making up these estimates. For instance, if I used these costs, and wanted to make a direct comparison of solid work with the earth rock throughout the Peninsula, without taking into account possible fluctuations and certain other contingencies which might arise, my estimate would be much lower. The instances that I am citing on rock work, and so on, are considerably harder rock than is encountered anywhere in the Peninsula. Also, on lots of work that is in the Peninsula, and which I presume is classed
8286 as solid rock in this inventory, is very much more comparable to the soft sandstones that we shot out at Daly City, and which stuff, in a flume bench, would be worth to quarry and trim off, about 50 cents a yard. It becomes after all a question of difficulty in blasting, rather than mere hardness of rock. If it were true that there were some slight differentiation, due to the rock work, it would not exceed 10 cents or 15 cents a yard in the handling of it. You can, of course, get all kinds of costs on rock work if you have not good men, and even with good rock men, there is always quite a gradation between them. You must have men who understand how to do the work most economically.

CROSS EXAMINATION BY MR. GREENE.

If I were going to do this work on the Peninsula, I would not have the men who were drilling the rock working on the earth excavation. I would not have them swinging from one thing to another. In the Peninsula you have the intermediate classification in the inventory of loose rock. I don't know where you consider that solid rock starts, and loose rock stops. I said that in the Sierras there were miles in which there was granite, and there 8287
were miles in which there was slate and earth. I didn't say that there was both granite and slate. As a result of that you had to have two separate gangs, one to handle the earth and one to handle the rock. I don't know whether that same procedure would be followed down here or not; it would make no particular difference. Without making more of a study of the ground, I have not thought that out in detail as to just how I would spot my gangs on it. Where I had the rock work down there, I would have drillers drilling the rock and shooting it, and probably have drilling gangs all along the line, preparing and getting ready to shoot. Those men would not turn around and go in on the earth work. Drilling crews are usually carried on under a straw boss, who looks after the drillers alone. He is a powder boss. My section in the Sierras on the ditch work was about 4 miles to a section, 2 miles each way; there were probably about 6 camps on the ditch. The powder sub-foreman would have drillers scattered back and 8288
forth over the 2 miles each way up and down the camp; of course, not ordinarily both ways, he would concentrate them more or less. There might be a main earth gang working on a long section of road; ordinarily he worked them in sets of 2, so far as the drillers were concerned, and they might be working at intervals of 500 or 1,000 feet, and the man would patrol there and supervise the work.

The Independent Gas Co. was the work that Mr. Hunt was engaged on, and that gas plant has been absorbed by the Pacific Gas & Electric Co.'s plant now, and is a part thereof. The amount of pipe laid by them in San Francisco ran somewhere, I think, between 80 and 100 miles of mains. They started out in a congested section; they covered south of Market, and they came across from the Potrero, and carried the big 30-inch line across Van Ness Avenue, and radiated out into the Mission. The company was organized, I think, in about 1900, and started construction in 1901, or possibly the beginning of 1902. They were just getting under way, and doing business on quite a scale when the Pacific Gas & Electric Co. absorbed them. I think they had a brand new organization, although I understood from Mr. Hunt that in construction he picked up men who were familiar with that class of work.

8289 Mr. Keppleman, I think, took charge of the Pacific Gas & Electric Co.'s work about the first of 1912, and it was done during the period of 1912, 1913 and 1914. It was trench and backfilling work in San Francisco, and so far as I know, they simply cut it and shoveled it out, and then shoveled it back, the same as everybody else does it. These figures were the figures submitted to us by the Pacific Gas & Electric Co. as the basis of all the pipe work in San Francisco, and which I accepted, and which is now on file before the Railroad Commission. I think the two pieces of work were closely comparable. I don't know of work that could be more comparable. The Independent laid its pipe in material covering the various classes of sub-soil as classed in this city. The Independent pipes were taken and classified according to the sub-soil classification which has been agreed upon here, and which is practically agreeable to the Pacific Gas & Electric Co.,
8290 and to the City. It is a general classification of sub-soil in San Francisco. Consequently, in getting a percentage of what was in soft rock, and what in hard clay, and so on, that was very easily determined. My recollection is that the range of sub-soils was very close in each one.

The fact that in one case it was a new plant, and in the other an old plant with a trained construction crew, has some application. I am not making the contention that if a direct resolution shows 60%, that you should not consider more than 20%, as indicated by these figures. I stated it more to show the fallacy of attempting to make direct resolutions of wage schedules and hours. There certainly would be a difference there, possibly due to the training of the organization of the Pacific Gas & Electric Co., but it would not be a difference that raises that percentage from 20 to 60 per cent.

8291 The increase of 6%, due to the change in hours from 10 to 9 hours, which I applied to the Spring Valley work possibly would be modified in different cases as a result of different influences assumed. As I say, it is not a question of absolute determination. The contention was that if you made a direct resolution which would probably indicate the maximum you could do, it was 12½%, resolving from a 10-hour day to a 9-hour day, and 25% resolving from a 10-hour to an 8-hour day. That represented the maximum percentage that you probably could claim. The minimum claim, although I am not in accord with it, is that you can get as much work out of 8 hours as you can in 10 hours; those are the two limits; my own personal judgment—and this is also borne out by the opinions of others on construction work, is that the difference is somewhere midway, about 12½% when you are resolving from a 10-hour day to an 8-hour day, or in the neigh-

borhood of 6%, or maybe 5%, or maybe 7%, when you are resolving from a 10-hour day to a 9-hour day.

Questioned by Mr. Metcalf. 8292

The new work, which was done by Mr. Hunt, may have been largely in the heart of the city and the busy district, whereas the work done by the Pacific Gas & Electric Co., as an old established company, may have been more in the outskirts of the city, where the difficulties from obstructions, and so on, would not be strictly compatible, but I hardly think that that influences the result to any great extent, for this reason: At best, this percentage is a tentative figure. I happen to have segregated a lot of trenching and backfilling, both of the Pacific Gas & Electric, and the Independent; this gave the major portion of the pipe laying, something in the neighborhood of from 50 to 60 miles of pipe laying; there were three main jobs. These are the average agreed costs of the Pacific Gas & Electric throughout the whole city, which we used in the inventory for trenching and backfilling. 8293

These costs are the determined costs of the Pacific Gas & Electric in this way: They base their cost figures on quite an elaborate study of all the work they had cost records of; then they submitted these figures as being their tentative figures on excavation and backfilling in their inventory. We examined these, and made a number of checks against them, and found that we considered it a very reasonable assumption all through. Those were for average conditions over the whole system, and they segregated two ways, excavation between hard ground and soft ground. I also took just the general average of Mr. Hunt's construction. I think Mr. Hunt's work represented conditions which were comparable to the average work, for this reason: That the work over these smaller sized pipes ran all through the Mission District, which is a comparatively light district; the balance of the Independent's work was largely south of Market Street, in Howard and Folsom Streets, and through there, and a few main arteries, and they had started to cross and get out in the Western Addition when they 8294
were absorbed. I don't think they reached the main business district down town at all.

Questioned by Mr. Greene.

Referring to the Central Reservoir segregation, the following charges come in the indirect charges: The building camp item is \$2,683; moving camp, \$156; painting house, \$55; water service, \$967; damage claim, \$139; miscellaneous engineering, \$536; draining, \$1,307; pick and shovel, \$1,007; spring clearing and piping, \$873; test pits, \$78. Those aggregate \$7,526, which are carried into the column headed "Indirect, 8" on that exhibit. The idle stock was segregated directly into the work as a direct charge, the same as the hay and so on. The quarrying cost went into the cost of rock which was charged in as material. All bills I saw for crushing rock on this were simply

8295 bills against the Buckman Construction Co., for rock at \$1.87 a yard, or something like that. It was a sale of rock, and to that extent it is in the material. It tends to reduce the overhead, according to Mr. Lippincott's basis of segregation. I didn't see any allowance for roads and trails in connection with the Central Reservoir. I am not familiar with the Central Reservoir; all I had to do was to make these computations along the lines indicated. Whatever items there were of that
8296 sort, I don't find any notation of them in that memorandum. I simply assembled the figures as they appeared on that series of sheets. If there was anything omitted there that was done by the company, it would not appear here.

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